PHASE II FINAL RCRA FACILITY ASSESSMENT

of the

SUN REFINING AND MARKETING COMPANY
(FORMERLY SUN PETROLEUM PRODUCTS COMPANY)
MARCUS HOOK REFINERY
MARCUS HOOK, PENNSYLVANIA

EPA I.D. NO. PAD980550594

Prepared for:

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I. INTRODUCTION

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) authorize EPA to require corrective action for releases of hazardous wastes and/or hazardous constituents from Solid Waste Management Units (SWMUs) and other Areas Of Concern (AOCs) at all operating, closed, or closing RCRA facilities. The intent of this authority is to address previously unregulated releases to air, surface water, soil, groundwater, and from the generation of subsurface gas. The first phase of the corrective action program as established by EPA is development of a RCRA Facility Assessment (RFA). The RFA includes a Preliminary Review (PR) of all available relevant documents, a Visual Site Inspection (VSI), and, if appropriate, a Sampling Visit (SV).

This report summarizes the results of the PR and VSI phases of the RFA for the Sun Refining and Marketing Company's (formerly Sun Petroleum Products Company) Marcus Hook Refinery (MHR) facility in Marcus Hook, Pennsylvania. The information in the report is based on a review of regulatory files collected from EPA Region III in Philadelphia, Pennsylvania and the Pennsylvania Department of Environmental Resources (PADER) southeastern regional office in Norristown, Pennsylvania, and a VSI performed August 20 - 23, 1990. Files reviewed include RCRA, CERCLA, TSCA, air, and water (NPDES).

This report is organized under eight chapter headings. Chapter II discusses the environmental setting of the facility including location and surrounding land use; climate and meteorology; topography, surface drainage and soils; and geology and hydrogeology. Chapter III provides a general facility description; history of ownership and land use; regulatory history; operations and process descriptions; wastes and waste management practices; history of releases; and a list of SWMUs and AOCs identified at the facility. Chapter IV provides descriptions of the SWMUs and AOCs identified at the Marcus Hook Refinery.

Chapter V is an executive summary, highlighting general information; processes and hazardous waste management practices; and a summary of SWMUs and AOCs with the recommended actions. Chapter VI describes release pathways and Chapter VII provides conclusions and detailed recommendations. Chapter VIII lists the references used in performing this assessment and preparing this report. The references are listed by subject area in the following order: solid waste files, water files, air files, and other files; and are generally organized chronologically within each subject area. In addition, there are three attachments. Attachment A is the SWMU and AOC Location Map. Attachment B is the Visual Site Inspection Photographs. Attachment C is the Visual Site Inspection Logbooks.

II. ENVIRONMENTAL SETTING

Location and Surrounding Land Use

The Sun Refining and Marketing Company's (formerly Sun Petroleum Products Company) Marcus Hook Refinery (MHR) is located in southeastern Pennsylvania, on the Pennsylvania/Delaware border, and on the western bank of the Delaware River. The facility is approximately 10 miles southwest of Philadelphia, Pennsylvania and 7 miles northeast of Wilmington, DE. Figure II-1 is a general location map showing its geographic location in southeastern Pennsylvania. Figure II-2 is a local area setting map showing the location of MHR within the Marcus Hook/Lower Chichester area. The facility consists of two plants; the Marcus Hook Oil Refinery, which is located in Marcus Hook Borough, Delaware County, PA, and the ethylene complex (previously the SunOlin Plant), which is located in Claymont, DE. The ethylene complex is on the western side of the MHR, on the Delaware River, and is contiguous with the refinery property. Both plants are located within the facility boundary shown in Figure II-2. The MHR is bounded by Ridge Road to the north, Green Street to the east, the Delaware River to the south, and other industrial properties to the west (References 13, 14, 349).

The MHR occupies approximately 400 acres of gently sloping land and has approximately 5,000 feet of frontage on the Delaware River. Land use patterns for the area immediately surrounding the refinery are predominantly industrial, with some areas of light residential use. The residential area of Marcus Hook, Pennsylvania is located immediately northeast of the facility. The residential areas of Linwood and Boothwyn, Pennsylvania are located approximately one and a half miles to the north of the facility (Reference 10).

Two major public transportation right-of-ways cross the MHR. Route 13, the Wilmington Post Road, crosses the facility parallel to the Delaware River from the southwest to the northeast and approximately bisects the refinery. The Washington - Baltimore — Philadelphia Penn Central railway lines also cross the facility, approximately 1000 feet to the north of and parallel to the Wilmington Post Road.

The Marcus Hook Refinery operates three other locations in the vicinity of the MHR that are not contiguous with the refinery, and thus are not considered to be part of the Marcus Hook Refinery facility for the purposes of RCRA corrective action. These locations are the Read-Boyd Farm, which is located approximately one mile and a half north of the refinery on Marcus Hook Creek; the No. 2 Tank Farm, which is located approximately three miles northeast of the refinery near the intersection of Routes 452 and 322; and the No. 3 Tank Farm, which is located on

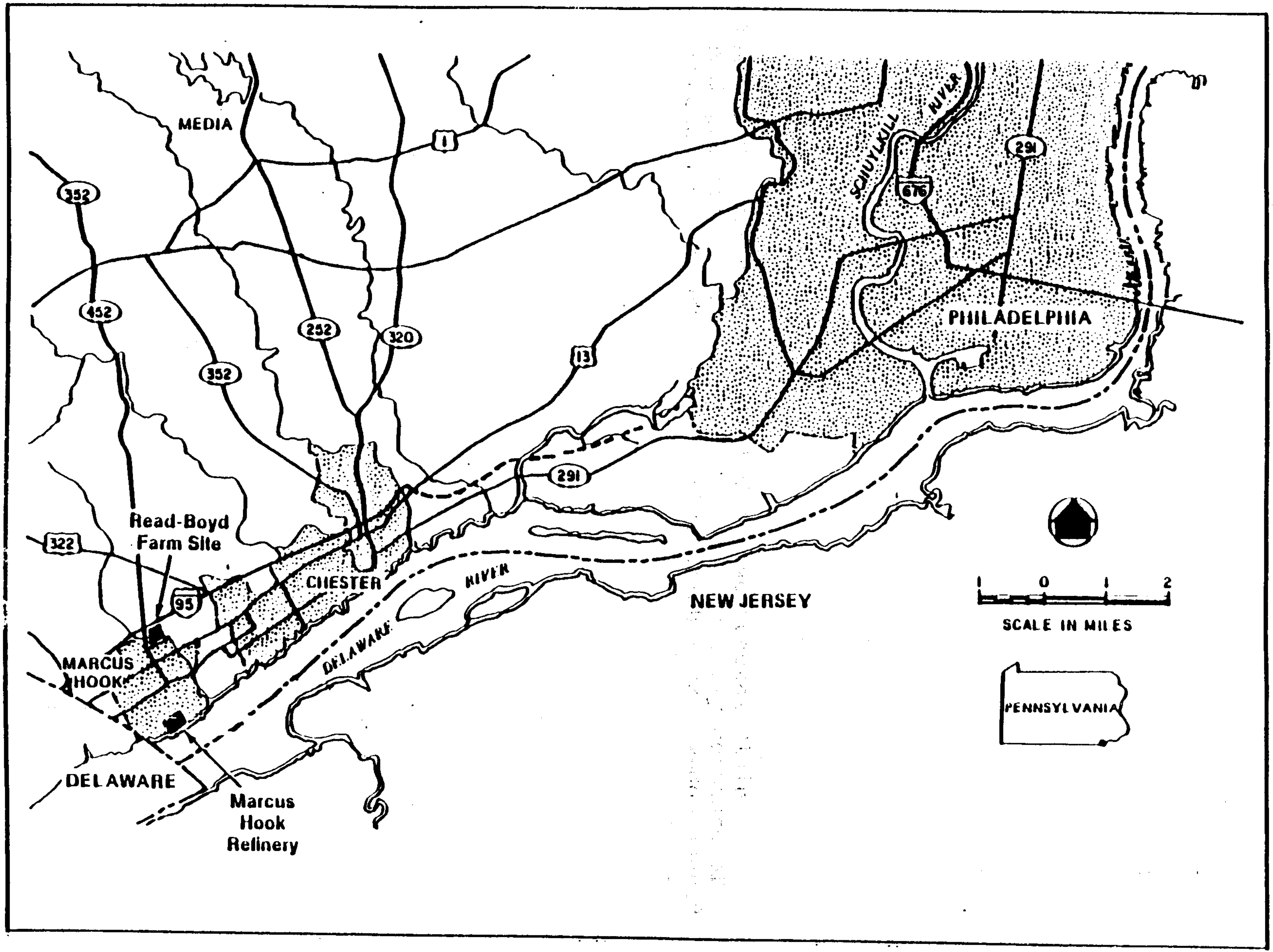
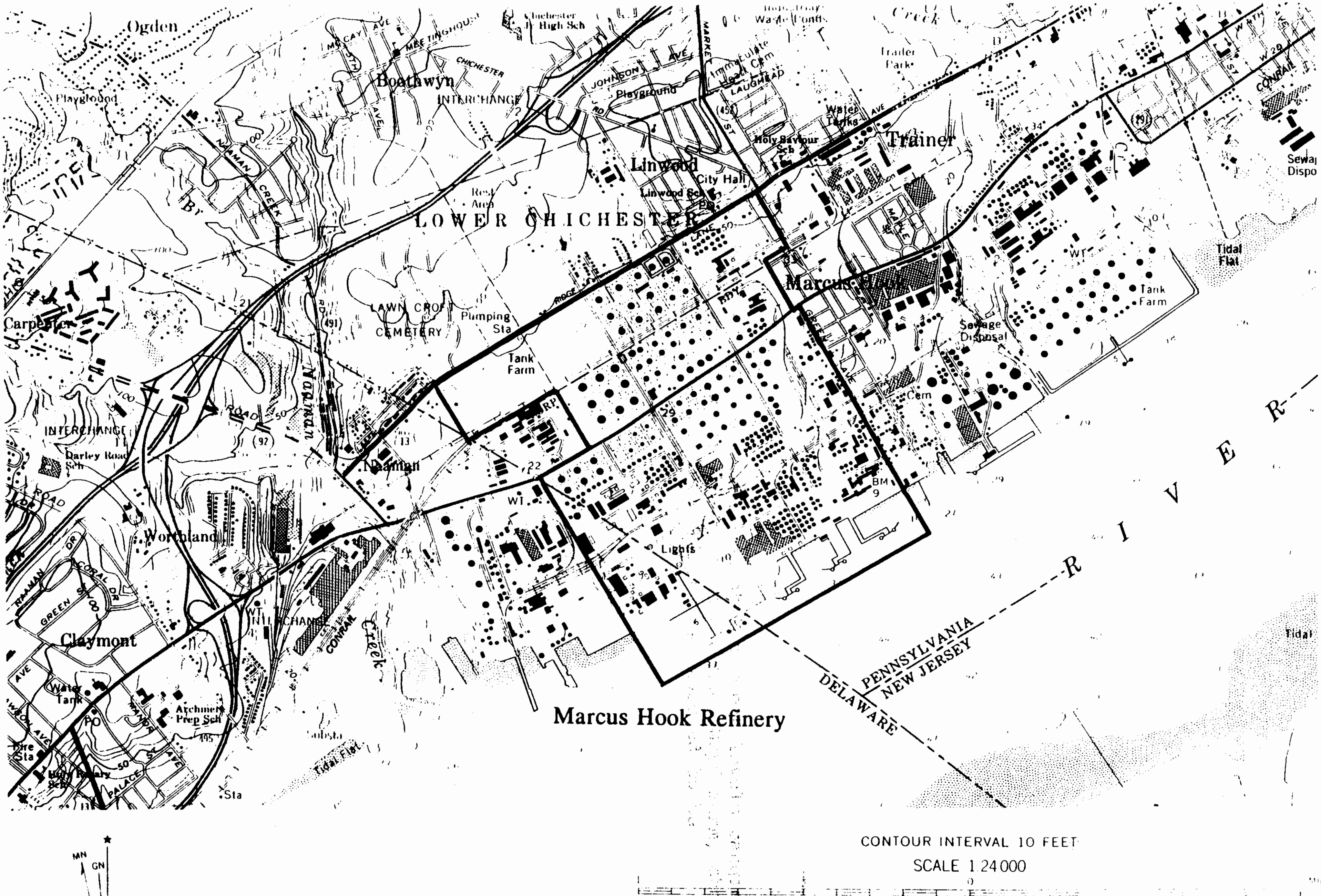


Figure II-1: Vicinity Map
(Reference 337)



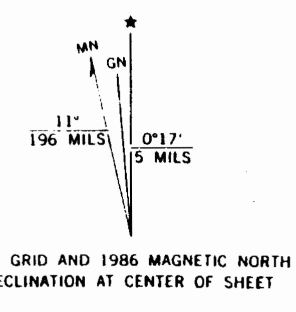


Figure II-2: Marcus Hook Vicinity Map
(Reference 354)

the Pennsylvania/Delaware border approximately two miles northwest of the refinery. The Read-Boyd Farm area was used to dispose of wastes from the refinery between the years of 1925 and 1971 and is no longer used for any operational purpose (References 5, 18, 349). Storage tanks are used to store gasoline and other products. **During the VSI, two tank farms were observed (Tank Farm Nos. 2 and 3). Subsequent to the VSI, the facility indicated that the tanks and lines at the No. 3 Tank Farm have been removed (Reference 372).**

Climate and Meteorology

The MHR is located in southeastern Pennsylvania, an area having a fairly moderate, humid, continental climate. Due to low topographic relief and proximity to the coast, the southeastern part of Pennsylvania is more humid and has more precipitation than western Pennsylvania. The mean annual temperature is 52° F, the average summer temperature is 72° F, and the average winter temperature is 32° F. The mean relative humidity for the area is 70%. Mean annual precipitation for the region is 41 inches. Precipitation is distributed relatively evenly throughout the year. Snowfall averaged 19.7 inches over a 20 year period between 1932 and 1952 for the winter months of December, January, and February. Snowfall averaged 5.4 inches during March for the same period. The prevailing wind direction in the area is from the southwest at 9.6 mph (References 100, 323, 355, 356).

Topography, Surface Drainage and Soils

The MHR is located in the topographic zone known as the Coastal Lowland region of the Appalachian mountains. This zone is predominantly a flat-lying to gently rolling erosional plain. Numerous small streams flow from the higher areas in the west across this erosional plain in a southeastern direction toward the Delaware River (Reference 349). Much of the area of the refinery has been disturbed for construction purposes or filled to stabilize areas near the river. Topographic relief at the refinery ranges from 50 feet above mean sea level (MSL) near Ridge Road to 10 feet **above** MSL at the Delaware River, resulting in total relief of less than 50 feet, sloping toward the river (Reference 354).

The 100-year flood elevation identified by the Federal Emergency Management Agency for the area is 10.0 feet. The majority of the refinery is located above this elevation, as are the Solid Waste Facility (SWMUs 1 - 21) (11.0 feet) and the Hazardous Waste Container Storage Pad (SWMU 22) (13.0 feet) (References 14, 354).

There are three creeks in the vicinity of the facility. These are Marcus Hook Creek, Naaman Creek, and Stony Creek. Stony Creek and Marcus Hook Creek are located north of the facility and are reportedly used for warm water fishing. Marcus Hook Creek flows from north to south until it reaches the Delaware River approximately one mile northeast of the facility. Naaman Creek also flows from north to south before joining the Delaware River approximately 4000 feet southwest of the facility. Tidal flats are located at the confluence of the Delaware River and Naaman Creek and along the river in the southeast section of the facility.

The major on-site drainage features of the refinery are the Middle Creek Surface Drainage System (SWMU 96) and the Delaware River. Figure II-3 illustrates the locations of the drainage streams. Precipitation falling within the facility is collected in Middle Creek (Reference 10). The Middle Creek Surface Drainage System (SWMU 96) drains from the northeast section of the facility flowing southward to the intersection of Green Street and 4th Street, then east to west across the refinery. The on-site creek flows parallel to the Delaware River until it reaches the western border of the refinery where it turns south and flows into the Delaware River. Both process wastewater and storm water from the entire refinery flow into the drainage system. An interceptor dam on Middle Creek forms a basin approximately 3,000 feet up stream from the confluence with the Delaware River. Water impounded behind the dam is pumped from the basin **through a final API separator system and then** to a sewer line connected to the Delaware County Regional Authority (DELCORA) treatment plant east of the refinery. Water in the Creek below the dam flows directly into the Delaware River. Prior to diversion of the wastewater managed in the Middle Creek Surface Drainage System (SWMU 96) to DELCORA, Middle Creek was classified as a Zone 4 Delaware Estuary, which supports warm water fish, migratory fish, boating, and fishing, and is a wildlife and industrial water supply. Two large diameter, underground sewers divert storm water from the towns of Linwood, Lower Chichester, and Marcus Hook to the Delaware River, without flowing through the refinery (References 110, 111, 134, 321, 349, **372**).

The facility is bounded to the south by the Delaware River for an approximate length of 5,000 feet. The Delaware is classified as a Zone 4 Delaware Estuary, which supports warm water fish, migratory fish, boating and fishing. The Zone 4 classification also indicates that the estuary is a wildlife water supply and an industrial water supply (Reference 134).

The soils underlying the Marcus Hook facility are almost entirely made land, gravelly materials. In "made land," soils have been covered by other materials or they have been removed to provide materials for industrial development. Made land gravelly materials consist of areas in which the profile of the normal soil has been destroyed or covered by earthmoving equipment used for urban or industrial development. In these areas the soil materials consist of sand, gravel, and clay in various mixtures,

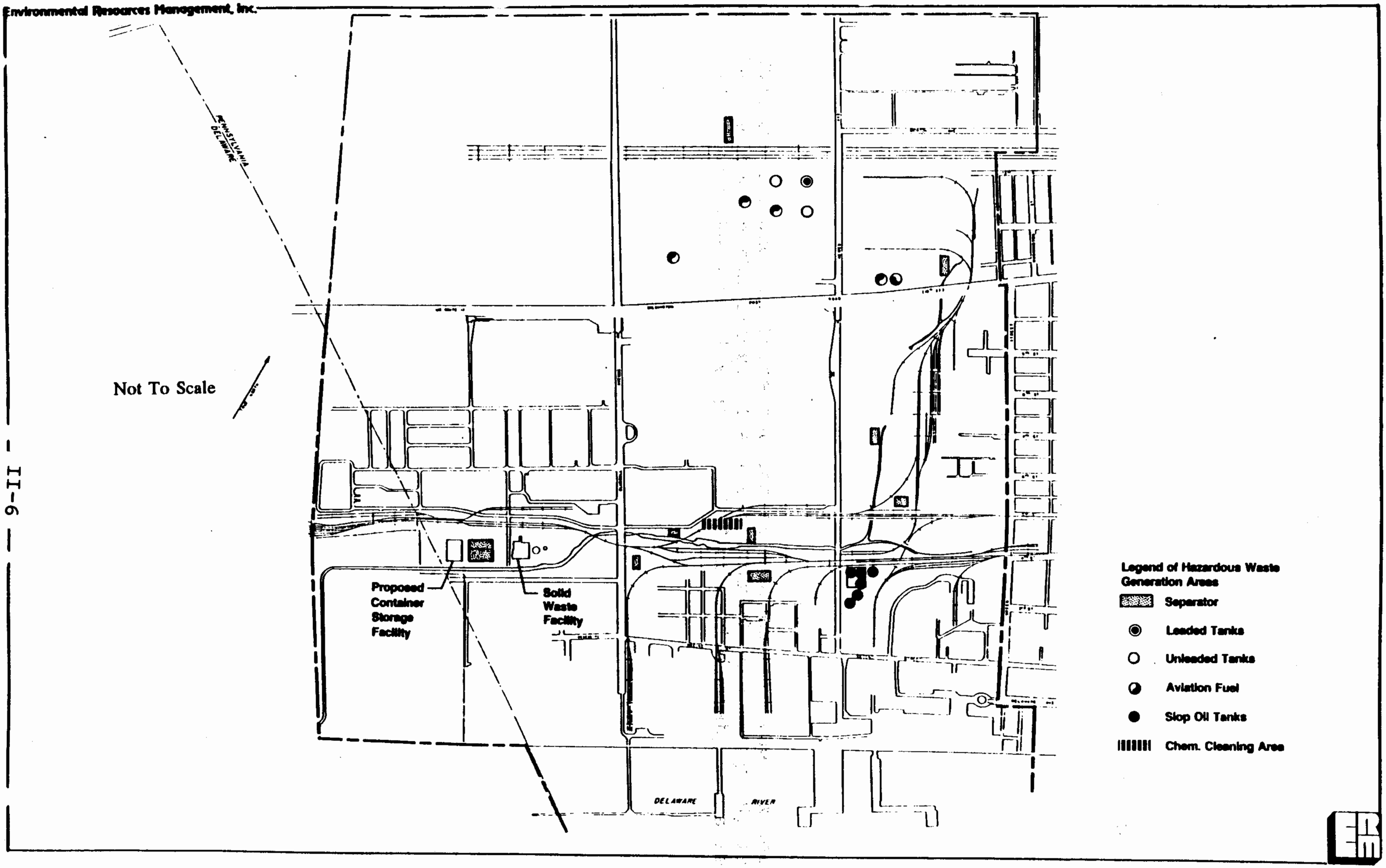


Figure II-3: General Layout of the Marcus Hook Refinery
(Reference 10)

but gravelly materials predominate (Reference 355).

The Phillips Island Area (SWMU 27) is an expansion area that was filled during the time period from the 1930s to the 1960s. The area consists of approximately 27 acres bounded on the southeast by the Delaware River, in the southwest section of the facility. The area extends into the river for approximately 200 feet. Prior to the 1930s the area was underwater. Phillips Island was reportedly constructed of granite rock that was excavated from the facility property during the construction of the natural gas facilities. Other fill materials include foundry slag, fly ash, and construction rubble. Waste catalyst fines, spent processing clays, leaded tank bottoms were also disposed at Phillips Island. Ten to 12 acres have been regraded to a one to two percent slope, away from the river (Reference 360). SWMUs located on the Phillips Island Area (SWMU 27) include the Phillips Island Maintenance Storage Area, Roll-Off Storage Area, Old Drum Storage/Small Roll-Off Storage Area, Fire Fighter Training Area, Impoundment Tank T-101, Surface Drainage Ditches, and Sand Blasting Area (SWMUs 28 - 34).

Geology and Hydrogeology

The Sun Oil refinery is situated in the Coastal Plain Physiographic Province. The province generally consists of Cretaceous to Recent age sediments, which form a wedge-shaped mass that thickens to the southeast. The site is approximately one mile southeast of the Fall Line, which defines the boundary between the Coastal Plain and Piedmont Physiographic Provinces (Reference 323).

The refinery is underlain by the Quaternary age Trenton Gravel. This unit consists of gray or pale reddish-brown, very coarse sand interstratified with crossbedded sand, clay, and silt beds. Underlying the Trenton gravel is the Pleistocene age undifferentiated Pennsauken and Bridgeton Formations. This unit consists of reddish-brown feldspathic quartz sand, some thin beds of fine gravel, and rare layers of clay or silt. The Pennsauken and Bridgeton Formations subcrop northwest of the site (References 323, 358).

A small area of anorthosite outcrops in the northeastern portion of the refinery, in the area of the 10 Plant and the northernmost Tank Farm (Reference 358). SWMUs located in the area of the 10 Plant include the 10-4 Plant Catalyst Fines Collection Roll-Offs, Roll-Off Storage Area, Spent Catalyst Silo, Electrostatic Precipitators, Sour Water Stripper, and Catalyst Regeneration Unit (SWMUs 35 - 44). SWMUs located in the northernmost Tank Farm include the 1A Oil/Water Separator (SWMU 63) and some of the Aboveground Tank Containment Areas (SWMU 98).

The early Paleozoic age Wissahickon Formation underlies the unconsolidated sediments. The Wissahickon is a highly folded, highly micaceous, medium- to coarse-grained oligoclase schist. A mantle of highly weathered and fractured rock, saprolite, generally overlies the Wissahickon bedrock. The Wissahickon schist outcrops to the northeast of the refinery, in the area of the Read-Boyd Farm (Reference 323, 358).

Ground water in the unconsolidated sediments moves through intergranular space and through primary porosity. Well yields in the unconsolidated sediments depend on the porosity and thickness of the deposit. Well yields in these aquifers have exceeded 500 gallons per minute. Ground water in the Wissahickon Formation occurs and moves through secondary porosity (fractures). Well yields in the Wissahickon Formation are dependent on the size and on the number of interconnecting fractures with the greatest yields occurring in the upper weathered zone (Reference 360).

Little site-specific information concerning ground water at the refinery was available, however, site-specific information for the Read-Boyd Farm, which is located one and a half miles to the northwest, was available. Based on the low topographic relief across the site, the nature of the subsurface materials, proximity to the Delaware River, and static water levels ranging from 0 to 30 feet below land surface at the Read-Boyd Farm, the water table in the area of the refinery is expected to be shallow. Facility representatives indicated that the water table is generally found at 10 feet below land surface at the refinery. Ground water flow direction is expected to be toward southeast the river (Reference 323).

III. FACILITY DESCRIPTION

General Facility Description

Sun Refining and Marketing Company's (formerly Sun Petroleum Products Company) Marcus Hook Refinery (MHR) is a thoroughly integrated complex with a crude oil run capacity of 165,000 barrels per stream day. Products manufactured at the MHR include: gasoline; kerosene; Nos. 1 and 2 fuel oils, residual fuel oils, and aviation fuel; liquefied petroleum gas; and petrochemicals (e.g., benzene, toluene, and xylenes). Gas streams containing hydrocarbons and sulfur that are generated are used by the refinery as a fuel source (Reference 349).

History of Ownership and Land Use

Prior to refinery activities the land in the MHR area was used as farm land and as an amusement park. Refinery operations were initiated in March 1902 (Reference 348). Data included on a list of process heaters at the facility with dates of installation indicate that refinery operations were active in the early 1900s; many of the currently operating units were installed in the 1940s and 1950s, one was installed in 1925, and one in 1938 (Reference 183).

The history of corporate entities having responsibility for the Marcus Hook Refinery is complex. The original notification of hazardous waste activity (Reference 1) and Part A Permit Application (Reference 2) identified the Sun Petroleum Products Company, a division of the Sun Oil Company of Pennsylvania, as the owner of the facility. The current owner of the MHR is the Sun Refining and Marketing Company (SRMC), which is a subsidiary of the Sun Company, Inc. (References 10, 14, and 353). Throughout the remainder of this report, SRMC will be used to identify the owner of the Marcus Hook Refinery, regardless of the name of the company that actually owned the refinery at the time.

The SunOlin Chemical Company property (now the ethylene complex), which is located in Claymont, Delaware, on the Delaware River to the west of the refinery, was purchased by SRMC in 1987. The Claymont plant is contiguous with the MHR and is part of the integrated complex. Prior to 1987, the SunOlin Claymont Plant was operated as a joint venture between SRMC and the SunOlin Chemical Company (References 13, 349).

Regulatory History

Operations at the MHR are subject to several types of environmental regulatory authorities, including hazardous waste management requirements, surface water discharge controls, pretreatment regulations, and air emission controls. With respect to RCRA regulation, the MHR submitted a notification of hazardous waste activity to the U.S. Environmental Protection Agency (EPA) on August 14, 1980. The notification indicated that the MHR was a hazardous waste generator, transporter, and treatment/storage/ disposal facility. The notification included 20 listed wastes and 2 characteristic wastes, and a third characteristic waste was later added to the notification via letter from SRMC to EPA. The wastes identified by MHR included the petroleum refining listed wastes, spent solvents, commercial chemical products, and ignitable, corrosive, and EP toxic characteristic wastes (References 1, 2).

SRMC submitted notification forms for four MHR operations which are situated in different locations, but was issued one EPA ID number for all four operations (PAD058974197) (Reference 5). After it was recognized that each location was a separate facility, the EPA issued four ID numbers, one for each location. The new ID number for the MHR was PAT000647420 (T = temporary number). A permanent number, PAD980550594, was later issued for the refinery (Reference 9). On November 11, 1980, SRMC submitted a Part A permit application for container storage, tank storage, and tank treatment of hazardous wastes (Reference 2). On January 5, 1981, EPA acknowledged the receipt of all documents necessary for the MHR to be eligible for Interim Status (Reference 3). On November 3, 1981, the EPA informed SRMC that all the requirements for achieving interim status under Section 3005(e) of RCRA had been met for the MHR (Reference 7).

On March 4, 1983, PADER formally requested that SRMC submit a Part B Permit Application for the MHR by September 1, 1983 (Reference 17). SRMC submitted a Part B Permit Application to PADER and EPA for a Solid Waste Facility (tank treatment) and a proposed Container Storage Facility at the MHR on August 31, 1983 (References 10, 52, 53). On August 27, 1984, PADER informed SRMC that the Part B was incomplete and requested additional information (Reference 35). SRMC supplied the necessary information and PADER declared the application complete on February 12, 1985 (Reference 70).

PADER notified SRMC of technical deficiencies in the application on December 17, 1985 (Reference 83). SRMC revised the application in response to those comments and PADER issued a draft permit for the MHR on April 27, 1990. Public comment was accepted on the draft permit for 45 days (Reference 14). PADER issued a final RCRA hazardous . Completion of the RCRA Facility Assessment (RFA), of which this preliminary review is part, is the first step in the process necessary for the EPA Region III Office to issue the HSWA, or corrective action, portion of the RCRA facility permit for the MHR.

In response to a petition from SRMC on June 15, 1983, PADER granted a delisting for two listed wastes generated and managed at the MHR. The two delisted wastes are API separator sludge (K051) and leaded tank bottoms (K052) from petroleum refining operations. The PADER delisting included a requirement that the wastes be treated at the MHR Solid Waste Facility prior to disposal, and stated that the delisting was applicable only within the Commonwealth of Pennsylvania (Reference 35). It should be noted, however, that the MHR permit application and draft permit cover treatment of both of those hazardous wastes, with no reference to the delisting.

In 1987, the SRMC bought the SunOlin Chemical Company facility located adjacent to the refinery in Claymont, Delaware. The SunOlin plant is within the fence line of the refinery and is now one of the MHR operating units, known as the ethylene complex. The SunOlin Chemical Company had notified the EPA of its hazardous waste generator activities in 1980 and was issued the EPA ID No. DED00229230. A note in the files indicates that SunOlin was a generator of between 100 and 1,000 kilograms of hazardous waste per month. The facility includes the refinery and the SunOlin Plant. They are contiguous, owned by one company, and for the purposes of RCRA corrective action, the generator of all wastes at both plants.

PADER's issuance of three notices of violation to the MHR were documented in the files. The first, issued on January 25, 1984, noted that the drum storage area had no containment, drums were open and rusted/corroded, and drums were not labeled correctly (Reference 63). The second, issued on March 13, 1985, cited MHR for storing drums of waste solvent for longer than one year (Reference 72). The third, issued on October 15, 1987, documented the results of a compliance inspection and included violations of requirements concerning inspection, recordkeeping, annual reports, closure cost estimates, use of the manifest, list of emergency coordinators, labeling of tanks, and hazardous waste treatment (Reference 103). The fourth, issued on January 3, 1989, also documented the results of a compliance inspection and noted violations concerning labeling of tanks, waste analysis plan, tank release controls, and other requirements (Reference 105).

The MHR has numerous other environmental permits for air emissions and water discharges. The facility discharges non-contact cooling water and other wastewaters to Middle Creek and the Delaware River under NPDES permit No. PA0011096 (Reference 108). SRMC has also been operating since 1980 under a Consent Order and Agreement with PADER that requires SRMC to upgrade the wastewater treatment systems at MHR (Reference 111).

The MHR NPDES permit covers discharges from the MHR (Outfall 101), and also regulates discharges from other off-site facilities operated by MHR (Outfalls 005, 006, and 007). Outfall 005 is located at the Read-Boyd Farm site and covers a discharge to Marcus Hook Creek from the waste lagoons; Outfalls 006 ar are located at the No. 2 Tank Farm and cover discharges to Baldwin Run via Sloppy Barr's Run (Reference 108). An application for renewal of the MHR NPDES permit was submitte SRMC in July 1979 (Reference 108).

According to the 1979 NPDES application, wastewater discharg off-site via Middle Creek and Outfall 101 included 1.1 milli gallons per day (MGD) of non-contact compressor cooling wate storm water. Information listed in the application also indicated 76.3 MGD of cooling water to be discharged off-sit after treatment at the 15 Oil/Water Separators (SWMUs 87 - 9 and the 9 and 14 Oil/Water Separators (SWMUs 70 - 79). Constituents expected to leak or spill into the discharge sy were cresol, cyclohexane, furfural, and xylene (Reference 10

SRMC and PADER signed a Consent Order and Agreement on Novem 24, 1980 that required SRMC to upgrade its wastewater treatm systems (Reference 108). Under the order, the facility was directed to repair the 15 Oil/water Separators (SWMUs 87 - 9 and to provide routine skimming and a spare pump. For the 9 14 Separators (SWMUs 70 - 79), the facility was directed to repair the wall between 9C and 9D (SWMUs 72 - 73) and to routinely skim the oil (Reference 108).

The 1986 NPDES permit application (the permit was issued and expire in 1991) indicated a discharge of 0.086 MGD consisting untreated groundwater seepage, storm water runoff, and overfl from the Middle Creek Dam. This discharge is monitored at monitoring point 101. Monitoring points 201 and 301 receive and 10 MGD of non-contact cooling water respectively. Monito point **501** is a combined monitoring point for **off-site stormwa and** non-contact cooling water originating from the 201 and 30 monitoring points. **Off-site stormwater is conveyed through t refinery and is discharged directly to surface waters via NPD points 501 and 020.** Sampling requirements for monitoring poi 101 included technology based parameters for biological oxyge demand (BOD), total suspended solids (TSS), chemical oxygen demand (COD), oil and grease, phenolics, total chromium, and hexavalent chromium. The water quality is also monitored for cadmium, copper, lead, mercury, nickel, zinc, pH, and benzene (Reference 134, 137, **372**).

On June 25, 1986, PADER issued SRMC a renewal of the NPDES permit, which SRMC appealed on July 22, 1986 (Reference 140). The resolution of this appeal was not documented in the files; however, on December 30, 1986, SRMC and PADER entered into a second Consent Order and Agreement (COA) (Reference 140). The COA included fines for numerous violations, and a detailed schedule for the design and installation of an upgraded wastewater treatment system. The COA requires that MHR be in compliance with the new permit limits by March 31, 1989 (Reference 140).

Numerous violations of the MHR NPDES permit limitations are documented in the files, both through Discharge Monitoring Reports (DMRs) (self-reporting) and PADER inspections. MHR has paid numerous fines for violations, and has been operating continuously under Compliance Order and Agreements, which contain stipulated penalties for failure to comply. Some of these violations were for the off-site outfalls rather than those at MHR, however, many are from the refinery Outfall 101. Violations documented for the 101 Outfall were most often for violation of oil and grease and Total Organic Carbon (TOC) limits.

The MHR is subject to various air emission control regulations including National Emissions Standards for Hazardous Air Pollutants - Benzene Sources (NESHAPs), New Source Performance Standards for Volatile Organic Compounds (VOCs), and visible emissions, particulate matter, and sulfur compound (SO_x) emissions limitations. The PADER has issued permits for numerous emissions sources at MHR; a list of permits included in Module 10 of a PADER permit application is presented as Table III-1 (Reference 18). The air permit numbers issued for SWMUs and AOCs at the facility are as follows. Permit number 23-312-052 has been issued for three of the 9 and 14 Oil/Water Separators (API Separators 9A, B, and C) (SWMUs 70 - 72); the 10 Oil/Water Separators (API Separators 10A and B) (SWMUs 81, 82); the 15 Oil/Water Separators (API Separators 15A and B) (SWMUs 87, 88); and the 16 Oil/Water Separators (API Separators 16A, B, and C) (SWMUs 84 - 86). Permit number 23-312-53 is for the Benzene/Toluene Vapor Recovery System (BTX Truck Unloading) (SWMU 55). These expire on June 30, 1993. Permit numbers 23-312-029 and 23-312-050 were issued for the 1F Oil/Water Separator (CPI Separator) (SWMU 68) and the 12A Oil/Water Separator (CPI Separator) (SWMU 83) and expired on November 12, 1981. Permit number 23-312-042 was issued for the Underground Storage Caverns (AOC E) and expired on November 12, 1978 (Reference 364).

Regulatory actions addressing air emissions from the MHR were first documented in the files in December 1971 (Reference 156). The files document numerous violations of air emissions regulations at the MHR from 1971 to the present. Over this time period, the MHR notified the PADER, in writing, of over 34 emissions incidents and provided explanations for the incidents including process upsets, maintenance procedures, and accidents.[1]

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[1] (References 195, 196, 197, 198, 199, 200, 203, 205, 208, 209, 231, 232, 233, 234, 237, 238, 239, 240, 251, 253, 256, 259, 276, 278, 285, 287, 288, 301, 303, 305, 307, 313, 315, 316)

TABLE III-1: MARCUS HOOK REFINERY ENVIRONMEN'
(REFERENCE 364)

AIR

SOURCE	PERMIT NO.	EXPIRATION	N
CO Boiler #2	23-302-044	6/30/93	Out (
Plt.8-C Proc.Htr.	23-302-044	6 30/93	
Plt.15-5 Pr.Htr.(3)	23-302-044	6/30/93	Prev.
Plt.15-1 Proc.Htr.	23-302-075	6/30/93	Prev.
Plt.12-3 Vac.Htr.	23-302-120	6/30/93	Prev.
Plt.12-3 Proc.Htr.	23-312-170	6/30/93	
CPI Separator	23-312-029	11/12/81	Inact:
Underground Cav.	23-312-042	11/12/78	Inact:
St.Tank #101	23-312-044C	5/31/93	
St.Tank #230	23-312-044C	5/31/93	Prev.2
St.Tank #237	23-312-044C	5/31/93	Prev.2
St.Tank #242	23-312-044C	5/31/93	
St.Tank #246	23-312-044C	5/31/93	
St.Tank #248	23-312-044C	5/31/93	
St.Tank #249	23-312-044C	5/31/93	
St.Tank #250	23-312-044C	5/31/93	
St.Tank #252	23-312-044C	5/31/93	
St.Tank #255	23-312-044C	5/31/93	Prev.23-
St.Tank #320	23-312-044C	5/31/93	Prev.23
St.Tank #344	23-312-044C	5/31/93	Prev.23-
St.Tank #347	23-312-044C	5/31/93	Prev.23-
St.Tank #348	23-312-044C	5/31/93	Prev.23-
St.Tank #349	23-312-044C	5/31/93	Prev.23-
St.Tank #353	23-312-044C	5/31/93	Prev.23-
St.Tank #354	23-312-044C	5/31/93	Prev.23-
St.Tank #355	23-312-044C	5/31/93	Prev.23-
St.Tank #357	23-312-044C	5/31/93	Prev.23-3
St.Tank #358	23-312-044C	5/31/93	Prev.23-3
St.Tank #383	23-312-044C	5/31/93	Prev.23-
St.Tank #385	23-312-044C	5/31/93	Prev.23-
St.Tank #387	23-312-044C	5/31/93	Prev.23-
St.Tank #389	23-312-044C	5/31/93	Prev.23-
St.Tank #390	23-312-044C	5/31/93	Prev.23-
St.Tank #443	23-312-044C	5/31/93	
St.Tank #452	23-312-044C	5/31/93	
St.Tank #467	23-312-044C	5/31/93	
St.Tank #524	23-312-044C	5/31/93	
St.Tank #491	23-312-044C	5/31/93	
St.Tank #593	23-312-044C	5/31/93	Prev.23-
St.Tank #598	23-312-044C	5/31/93	
St.Tank #599	23-312-044C	5/31/93	
St.Tank #610	23-312-044C	5/31/93	
St.Tank #611	23-312-044C	5/31/93	
St.Tank #F23	23-312-044C	5/31/93	Prev.23-
Ground Flare	23-312-045	Temporary	Reapply (
CPI Separator	23-312-050	11/12/81	Inactive
Fume Incinerator	23-312-051	1/9/78	Inactive

TABLE III-1 (CONTINUED)
MARCUS HOOK REFINERY ENVIRONMENTAL PERMITS (REFERENCE 364)

AIR

SOURCE	PERMIT NO.	EXPIRATION	NOTES
API Sep.#9 ABC	23-312-052	5/31/93	Out of Service
API Sep.#10 AB	23-312-052	5/31/93	Prev.23-312-145
API Sep.#15 AB	23-312-052	5/31/93	Prev.23-312-146
API Sep.#16 ABC	23-312-052	5/31/93	Prev.23-312-147
BTX Trk.Unloading	23-312-053	9/30/91	
St.Tank #316	23-312-071	8/31/93	Prev.23-312-071
St.Tank #317	23-312-071	8/31/93	Prev.23-312-072
St.Tank #323	23-312-071	8/31/93	Prev.23-312-108
St.Tank #324	23-312-071	8/31/93	Prev.23-312-109
St.Tank #327	23-312-071	8/31/93	Prev.23-312-110
St.Tank #328	23-312-071	8/31/93	Prev.23-312-111
St.Tank #329	23-312-071	8/31/93	Prev.23-312-112
St.Tank #331	23-312-071	8/31/93	Prev.23-312-113
St.Tank #333	23-312-071	8/31/93	Prev.23-312-114
St.Tank #321	23-312-071	8/31/93	Prev.23-312-127
St.Tank #1	23-312-088	8/26/81	Inactive
St.Tank #2	23-312-089	8/26/81	Inactive
St.Tank #3	23-312-090	8/26/81	Inactive
St.Tank #4	23-312-091	8/26/81	Inactive
St.Tank #332	23-312-096	8/26/81	Inactive
Banking-Tk.#312 313,317,325 & 326	23-312-149	8/31/86	Inactive
Gasoline Loading	23-312-169	6/30/94	
Banked Emissions	23-325-003		Expired
Cogeneration Unit	23-399-018	3/31/91	
Opacity CEM,FCCU	CEMS 1582		

WATER

DESCRIPTION	NUMBER	EXPIRATION
Water Quality Mgmt.		
-Upper #1 Tk.Farm	2375203	Issued 11/76
-Refinery	2379202	Issued 6/81
Sanitary Wastewater	1172	N/A
Sanitary Wastewater	870	N/A
Sanitary Wastewater	512	N/A
NPDES	PA0011096 (Renewed 6/25/86)	6/25/91

For the same time period, at least 15 site inspections conducted by the PADER[2] and over 15 citizen complaints concerning air emissions events are documented in the files.[3] Sixteen letter agreements between the PADER and SRMC documenting fines levied against the MHR for air emissions violations were found in the files.[4] The limits most frequently exceeded were particulates, visible emissions, and SO_x. The fines agreed to ranged from $500 (References 249, 263) to $20,000 (Reference 280). The PADER also issued four Notices of Violation with no associated penalties (References 284, 286, 293, 299).

The majority of the violations issued and concerns noted in correspondence from PADER to SRMC refer to the Fluid Catalytic Cracking Unit (FCCU). Eleven of the 16 letter agreements concern emissions from the FCCU. On September 19, 1972 SRMC petitioned the PADER for a temporary variance from the particulate emissions standards to allow the facility time to complete modifications necessary to bring the unit into compliance. A variance was granted, which, after one extension, expired on December 31, 1973. The PADER found that the FCCU unit continued to be out of compliance after this date and on December 16, 1974 issued a consent decree to SRMC requiring compliance by March 31, 1975 and levying fines of $30,000 for the past violations. The order also included stipulated penalties of $10,000 per month if compliance was not achieved by March 31, 1975 (References 176, 177). Recent concerns about air emissions from the facility have involved the control of VOC and benzene emissions (Reference 349).

Also documented in the files are numerous violations of visible air emissions limitations from ships anchored near or docked at the MHR docks on the Delaware River.[5]

File information obtained from the CERCLA program office at the EPA Region III office was found not to be applicable to the MHR. The files document Superfund program activity at the Read-Boyd Farm site which is owned by MHR but is not contiguous to the refinery. The Read-Boyd Farm is located approximately one and a half miles to the north of the refinery, near the intersection of

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2 (References 185, 186, 191, 221, 229, 242, 246, 247, 248, 252, 254, 261, 296, 304, 310)

3 (References 157, 190, 192, 202, 220, 225, 227, 235, 256, 264, 265, 297, 302, 311)

4 (References 241, 244, 249, 250, 257, 258, 263, 264, 272, 279, 280, 282, 290, 294, 298, 308)

5 (References 201, 204, 210, 211, 212, 213, 218, 219, 260, 320)

I-95 and Route 452. There are 3 waste piles, 11 major disposal pits, and 7 treatment and settling ponds at the Read-Boyd Farm Site that were used for disposal of wastes from the MHR between the years of 1925 and 1971. The files reviewed indicate that a Preliminary Assessment/Site Investigation was conducted for the site, but no documentation of Hazard Ranking System (HRS) scoring or further CERCLA activity was found. At the time of the Site Inspection (1980) the PADER was negotiating a consent order with Sun for remedial action (References 323, 329).

Operations and Process Description

The Marcus Hook Refinery processes up to 165,000 barrels per day (BPD) of crude oil. The majority of the crude processed is 0.2% sulfur by weight and arrives by tanker from North Sea and African oil fields (Reference 10).

The refinery consists of a series of plants that carry out the processing operations necessary to convert crude oil into various products. The basic processes include cracking, distillation, reforming, cleaning, and blending. In general, cracking refers to the process of splitting long chain hydrocarbons into shorter ones. This operation is the central operation of the refinery. Distillation utilizes the differences in boiling points of the hydrocarbon fractions to separate each fraction out of the petroleum feedstock. Reforming operations convert straight-chain hydrocarbons into simple aromatics such as benzene, or more complex compounds. Cleaning operations involve removing unnecessary contaminants from products. Blending operations involve blending various intermediates to formulate final products (Reference 349).

The Marcus Hook Refinery processes are complex and involve numerous plants that are located throughout the facility. The major operations and associated process units are listed and discussed briefly below. Figure III-1 presents a generalized flow diagram for the refinery processes discussed and Figure III-2 illustrates the locations of the major process units within the refinery complex.

DISTILLATION (Plants 8-C, 12-3, 15-1) (labeled Crude Distillation on Figure III-1) — There are three distillation systems at Marcus Hook that separate desalted crude petroleum into various fractions. Each system consists of an atmospheric distillation unit (ADU) (Plant 15-1), or an ADU and a vacuum distillation column (VDC) (Plants 8-C and 12-3). Some of the separated hydrocarbon fractions are used as feed for subsequent process units (wet gases, straight run gasoline, light naphtha, heavy gas oils, and heavy bottoms) and some are sold as product after impurities are removed (furnace oils) (References 324, 349).

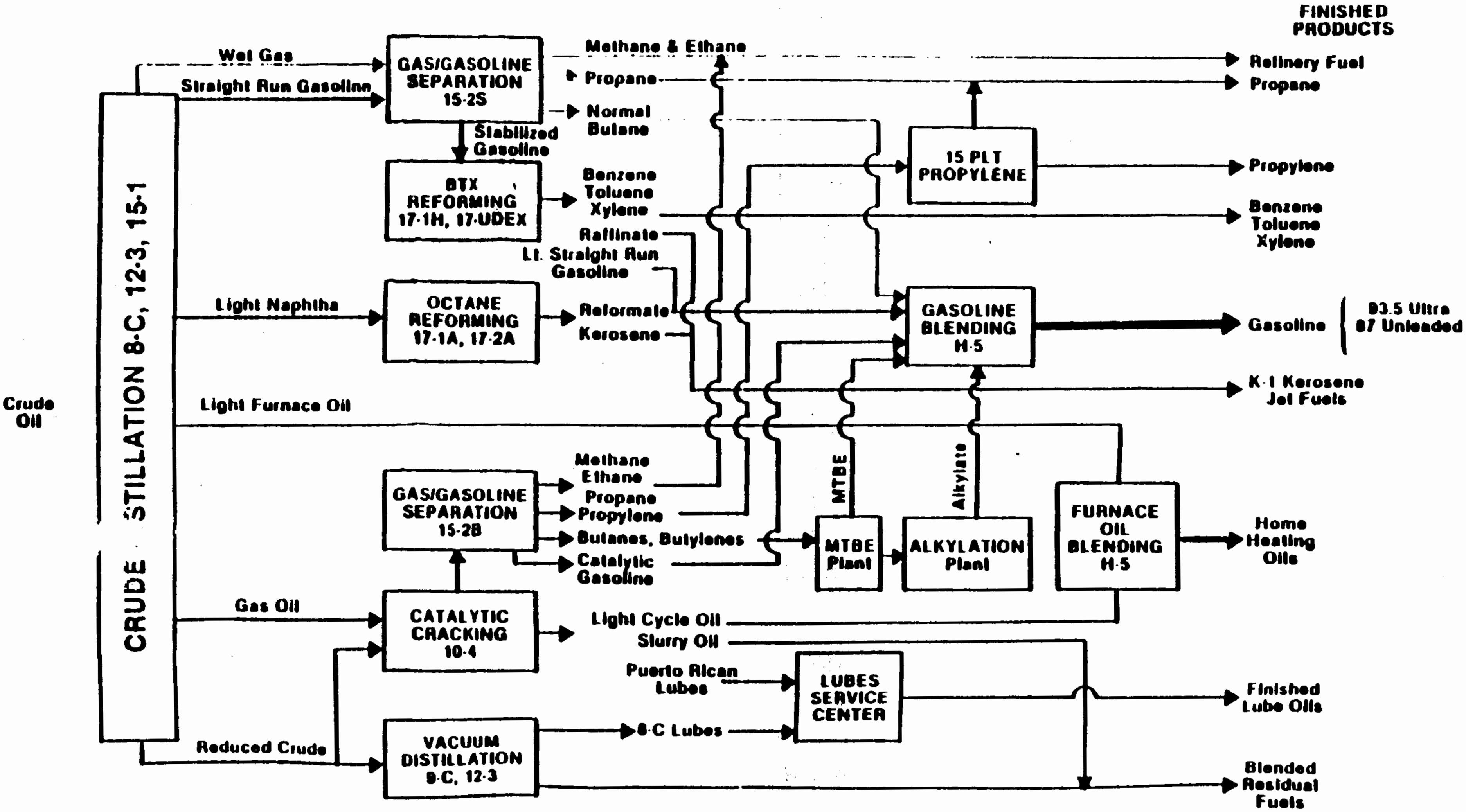


Figure III-1: Major Plants Process Flow Sheet
(Reference 349)

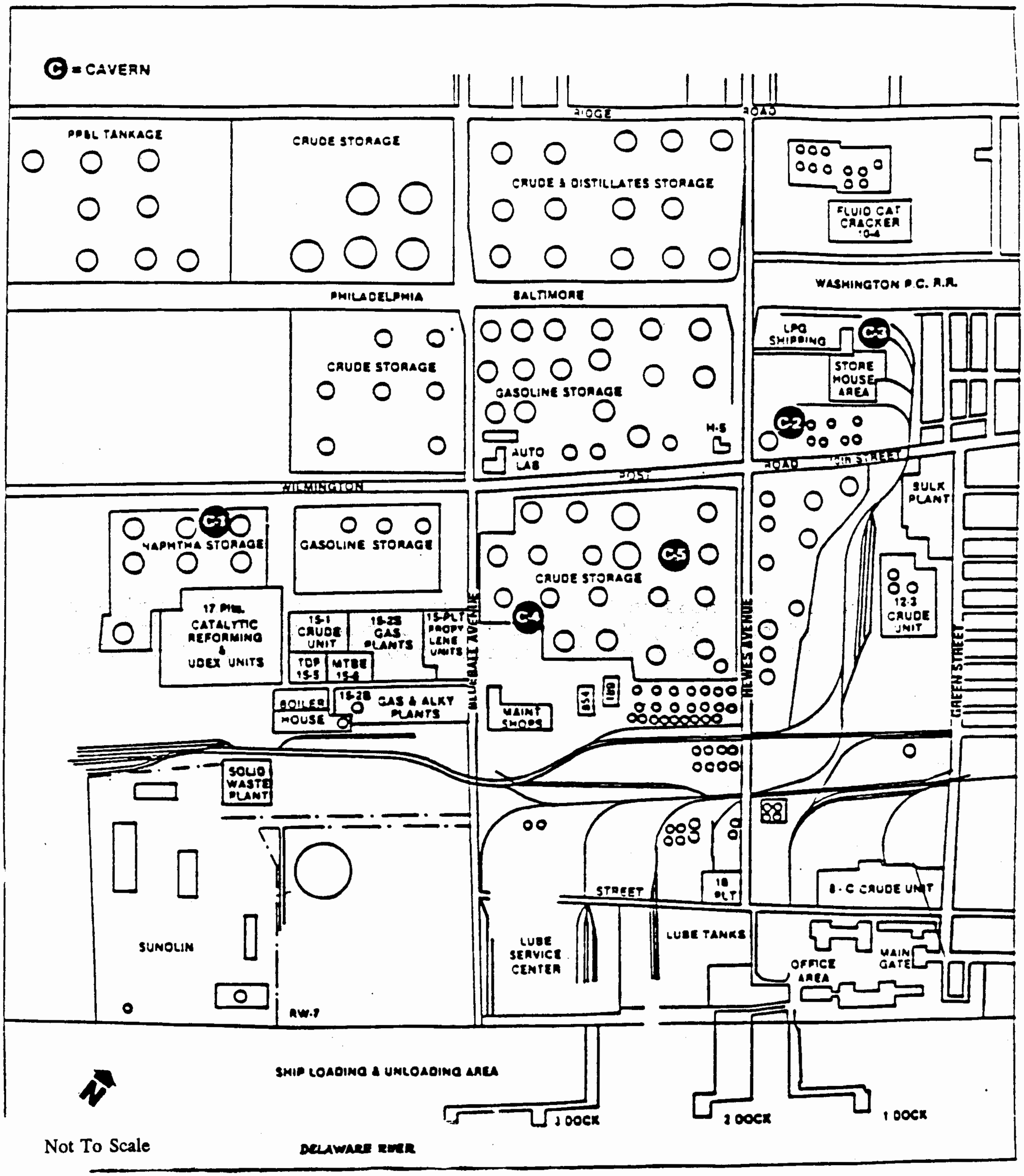


Figure III-2: Facility Plot Plan
(Reference 349)

CATALYTIC CRACKING (Plant 10-4; labeled Catalytic Cracking on Figure III-1; located in the northeastern quadrant portion of refinery) — One fluidized catalytic cracking unit (FCCU) is used at Marcus Hook to split long chain hydrocarbons into high octane compounds for gasoline and fuel oil blending. The feedstock for the FCCU is separated fractions from the distillation plants, particularly heavy gas oils. The catalyst used in the FCCU becomes contaminated through use and regeneration is required. Spent catalyst fines are collected in an emission control system (References 324, 349).

ABSORPTION/STRIPPING (Gas/Gasoline Separation Plants 15-2S and 15-2B; located in the southwestern quadrant of the refinery) — Two gas plants are used to absorb/strip and separate butane and butylene (4-carbon) and propane and propylene (3-carbon) hydrocarbon fractions. Some of the recovered streams are sold directly as product and some are further processed in other operations. A gas stream from the operation is used to produce refinery fuel gas or is sent for use as feed at the SunOlin Claymont plant (References 324, 349).

CATALYTIC REFORMING (Plants 17-1A, 17-2A, 17-1H; labeled as Octane Reforming on Figure III-1; located in the southwestern quadrant of the refinery) — Three catalytic reformer units (CRUs) are used at the Marcus Hook Refinery to convert certain hydrocarbon fractions from the Gas Plants to cyclic and aromatic fractions. CRU 17-1H is part of the petrochemical operation discussed below. CRUs 17-1A and 17-2A produce input streams for gasoline and jet fuel blending or kerosene blending (References 324, 349).

PETROCHEMICAL OPERATIONS (Plants 17-1FP, 17-1H, 17-2; labelled BTX reforming on Figure III-1; located in the southwestern quadrant of the refinery) — The petrochemical production process utilizes a distillation column (Plant 17-1FP), a catalytic reformer (Plant 17-1H), and a Udex® unit (Plant 17-2) to produce benzene, toluene, and xylene (BTX). The feed for this process is a gasoline stream from one of the Gas Plants. BTX are formed in the presence of a catalyst in the CRU, and the Udex® plant separates the benzene, toluene, and xylene into separate streams using distillation (References 324, 349).

TOLUENE DISPROPORTIONATION (Plant 15-5; not shown on Figure III-1; located in the 15 Plant area in the southwestern quadrant of the facility) — Benzene and xylene are also produced using the toluene stream from the Udex® plant and other recycled toluene. The Toluene Disproportionation (TDP) plant forms benzene and xylene in the presence of a catalyst (References 324, 349).

GAS/GASOLINE SEPARATION (Plant 15-2B) — The gasoline stream from the FCCU (Plant 10-4) is treated at Plant 15-2B, which removes impurities, converts mercaptans to disulfides, and washes sulfur compounds and phenols from the gasoline. The cleaned gasoline is sent to the gasoline blending plant (Plant H-5) (References 324, 349).

METHYL-TERT-BUTYL ETHER PRODUCTION (MTBE Plant 15-6) — Isobutylene from the gas/gasoline separation process reacts with methanol and is converted into MTBE in the presence of a catalyst. The MTBE is used in the gasoline blending process (References 324, 349).

ALKYLATION (Alkylation or Alky Plant; located in the 15 Plant area) — Untreated isobutylene from the MTBE plant and 4-carbon fractions from the FCCU are treated with caustic to remove sulfur compounds and then react in the presence of sulfuric acid to produce a high octane fraction that is used in the gasoline blending operations (References 324, 349).

LUBE OIL BLENDING (Lubes Services Center in Figure III-1; located in the south central part of the facility) — Finished lubrication oils are blended at the Lubes Services Center from lube cuts generated in one of the distillation columns (8-C) and other lube oils (References 324, 349).

GASOLINE AND FURNACE OIL BLENDING (Plant H-5) — Finished gasoline and furnace oil products are blended from various input streams at Plant H-5, located northwest of the intersection of Hewes Avenue and Wilmington Post Road (References 324, 349).

ETHYLENE COMPLEX (formerly the SunOlin Chemical Company, Claymont Plant; located in the southwestern quadrant of the refinery) — Waste gases generated at the refinery are sent through an overhead pipeline to the ethylene complex, which is located on the Delaware River on the southwestern side of the refinery. The refinery fuel gas streams, which are rich in ethylene, are used as feedstock for the ethylene processes. Ethylene is recovered after an MEA (monoethanolamine) absorber tower is used to remove sulfur. The ethylene is sold as a product and also used to produce ethylene oxide and ethylene glycol. Spent MEA solutions generated both at the Marcus Hook Refinery and the ethylene complex plant are regenerated at the ethylene complex, and a residual sulfur-rich gas stream is sent to a nearby chemical plant for use in sulfuric acid production (Reference 349).

PRODUCT AND FEEDSTOCK STORAGE — (Tank Farms) The Marcus Hook Refinery utilizes approximately 450 tanks for storage of finished products and feedstocks. The various tank storage areas (crude, gasoline, distillates, naphtha) are identified on Figure III-2. Five underground caverns (Underground Storage Caverns AOC E) are also used at the Marcus Hook Refinery to store products produced at the plant. The locations of the caverns are illustrated on Figure III-2. Product is stored in the caverns under pressure (References 324, 349, and 366). Additionally, it has been reported, but not documented, that crude oil was stored in unlined impoundments in the waterfront area during the early years of refinery operations (Reference 367).

LOADING AND UNLOADING OPERATIONS - (Docks 1 - 3; Benzene/Toluene Tank Truck Loading Facility; Gasoline Loading Facility) Crude oil is unloaded and products are loaded onto ships at the three MHR docks on the Delaware River. Products are loaded onto tanker trucks and railcars at various locations (References 164, 168, 181).

<u>Wastes and Waste Management Practices</u>

Past and present waste management activities at the Marcus Hook Refinery can generally be described as four interconnected systems, management of wastes generated in particular process areas, and a number of ancillary activities. The systems and activities, the wastes that are generated and/or managed in each, and the associated SWMUs are described in the following subsections of this report. A generalized flow diagram for waste management at MHR is presented as Figure III-3.

The four interconnected systems are the wastewater management system, the slop oil system, the system used to manage refinery sludges and slurries, and the general refuse and other materials collection and disposal system. The specific process areas in which wastes are managed include the 10-4 Plant and the Mechanical Shop/Garage. The ancillary activities include equipment cleaning and maintenance activities; loading and unloading and materials transport operations; product storage activities; fire fighter training, and past activities no longer conducted.

Wastewater Management System

Wastewater generated at the MHR has generally consisted of process wastewater generated in production operations, non-contact cooling water, surface runoff from process and non-process areas, and surface runoff collected in tank containment areas. It is likely that similar types of wastewaters have been generated since operations first started at MHR in the early 1900s. The system used to manage these wastewaters has evolved over time in response to changing regulatory requirements and process needs.

It is believed that wastewater from the refinery has been discharged to the natural surface water flow system within the refinery and to the adjacent Delaware River since operations first started at MHR (Reference 369). The natural flow system consisted of Walker's Run, Middle Creek, and Bear Creek. Walker's Run and Bear Creek flowed into Middle Creek, which flowed into the Delaware River. No documentation of any

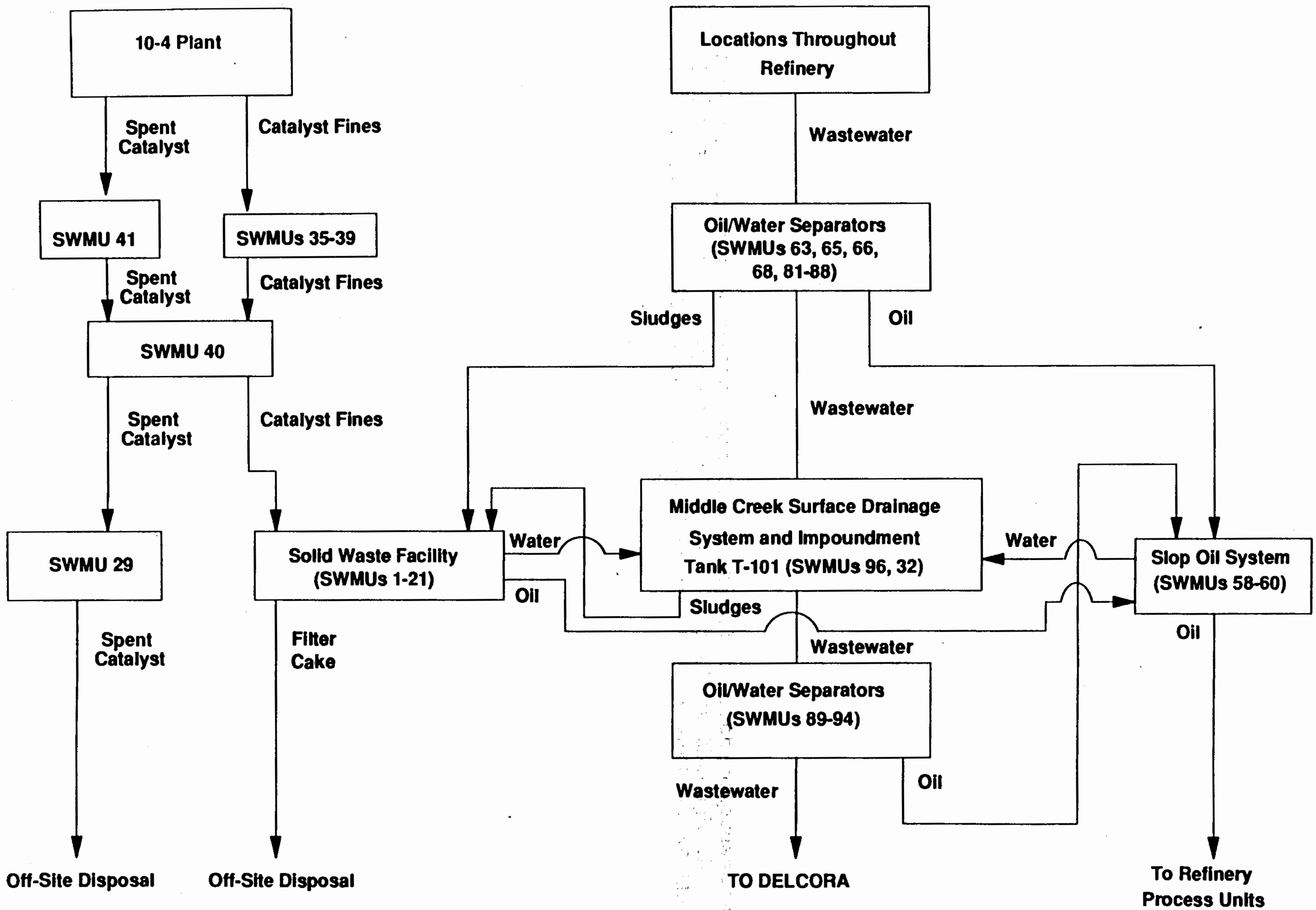


Figure III-3: Waste Flow Diagram

wastewater treatment conducted prior to discharge during the early 1900s was found in the files or reported by facility representatives. In the 1940s and 1950s, API oil/water separators (built to American Petroleum Institute (API) specifications) were added to separate oil and solids from process wastewater prior to discharge to surface waters. Additional oil/water separators, of in-ground corrugated plate design, were added in the early 1970s (Reference 369).

In the late 1960s and early 1970s additional changes were made to the wastewater treatment system in response to increasing controls on discharges to surface waters imposed under the Clean Water Act. Figure III-4**a** illustrates the wastewater management system in use in the early 1980s. **Figure III-4b depicts the current wastewater flow.** An interceptor dam was constructed across Middle Creek near its confluence with the Delaware River to keep contaminated wastewater from the refinery from being discharged to the Delaware. Water from behind the dam was piped off-site to the new DELCORA regional wastewater treatment plant in Chester, PA for secondary treatment. Wastewater flows from the majority of the facility and most of the oil/water separators flowed into Middle Creek above the dam. Non-contact cooling water (from the York and Elliott compressors and the propane warming unit) and some refinery wastewater from oil/water separators was discharged to Middle Creek (and then to the Delaware) below the interceptor dam (Reference 111, **372**).

Surface water flow from the areas to the north of the refinery, which are generally residential and light commercial areas, was diverted from the northern boundary of MHR to the Delaware through two underground bypass sewers. Flow from the northwestern areas flows through the Linwood Bypass and is discharged into Middle Creek below the interceptor dam. Flow from the north and northeastern areas flows through a 26 inch sewer line along the eastern border of MHR to the Delaware (References 111 and 369).

The current wastewater management system at MHR is illustrated in Figure III-5. In general, all refinery wastewaters (with several exceptions) flow directly to, or to oil/water separators which discharge to, Middle Creek or Walker's Run above the interceptor dam. The wastewater is collected from all areas of the facility through drains and pipelines that have been identified as the Combined Process/Storm Sewer System (SWMU 95) and the Phillips Island Surface Drainage Ditches (SWMU 33). The Middle Creek/Walker's Run surface water system has been identified as the Middle Creek Surface Drainage System (SWMU 96). Of the API separators installed in the 1940s and 1950s, the 1A, 1C, 1D, 10, and 16 Oil/Water Separators (SWMUs 63, 65, 66, 81, 82, 84 - 86) are still in use and discharge to Middle Creek. API oil/water separators no longer in use include the 1B, 1E, 9 and 14 Oil/Water Separators (SWMUs 64, 67, 70 - 79). The corrugated

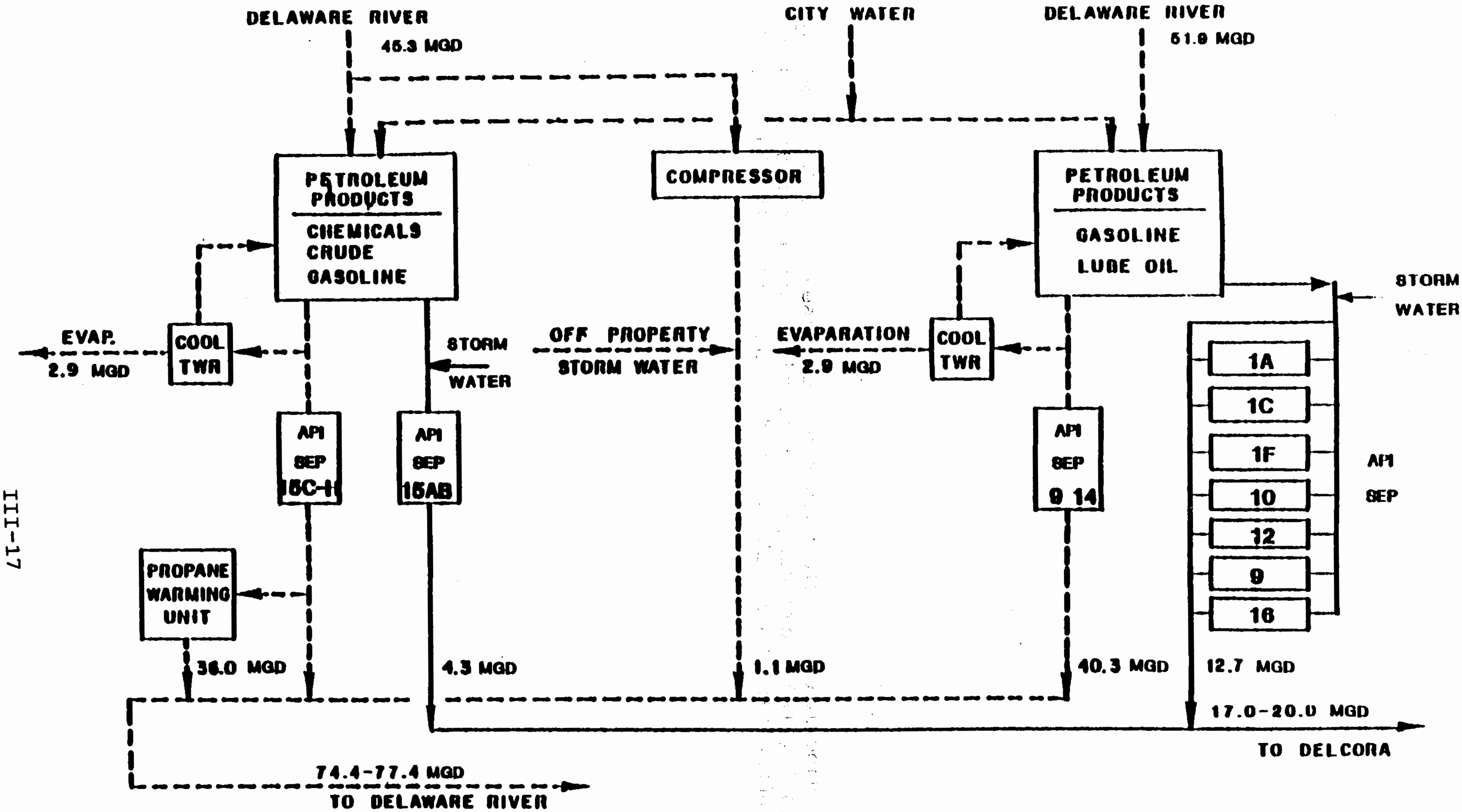
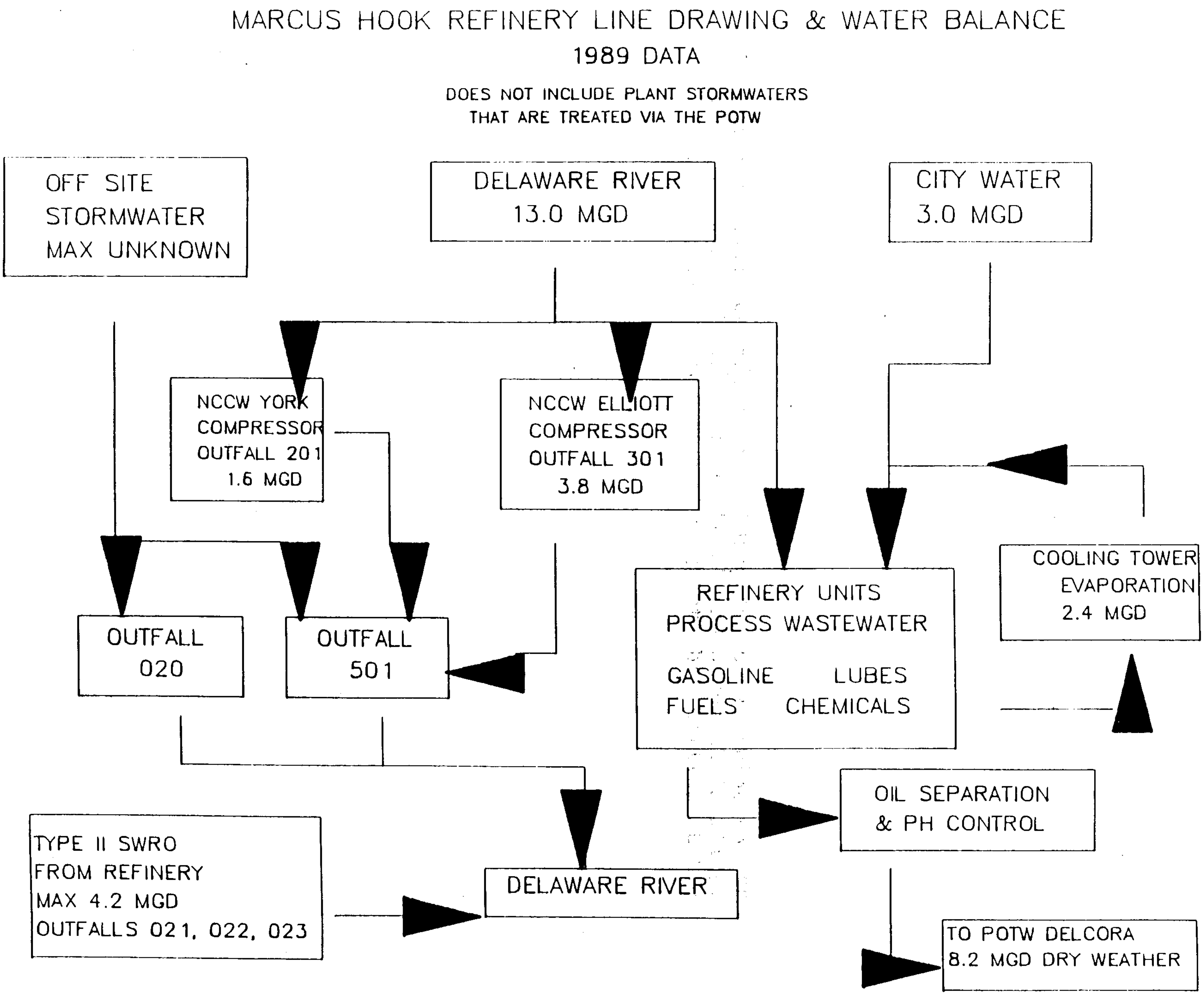


Figure III-4a: Wastewater Flow; 1980
(Reference 111)

LINE LEGEND
- - - - - - NON-CONTAMINATED WATER
———— CONTAMINATED WATER

Figure III-´´ Current Wastewater Flow (Re´ ence 372)



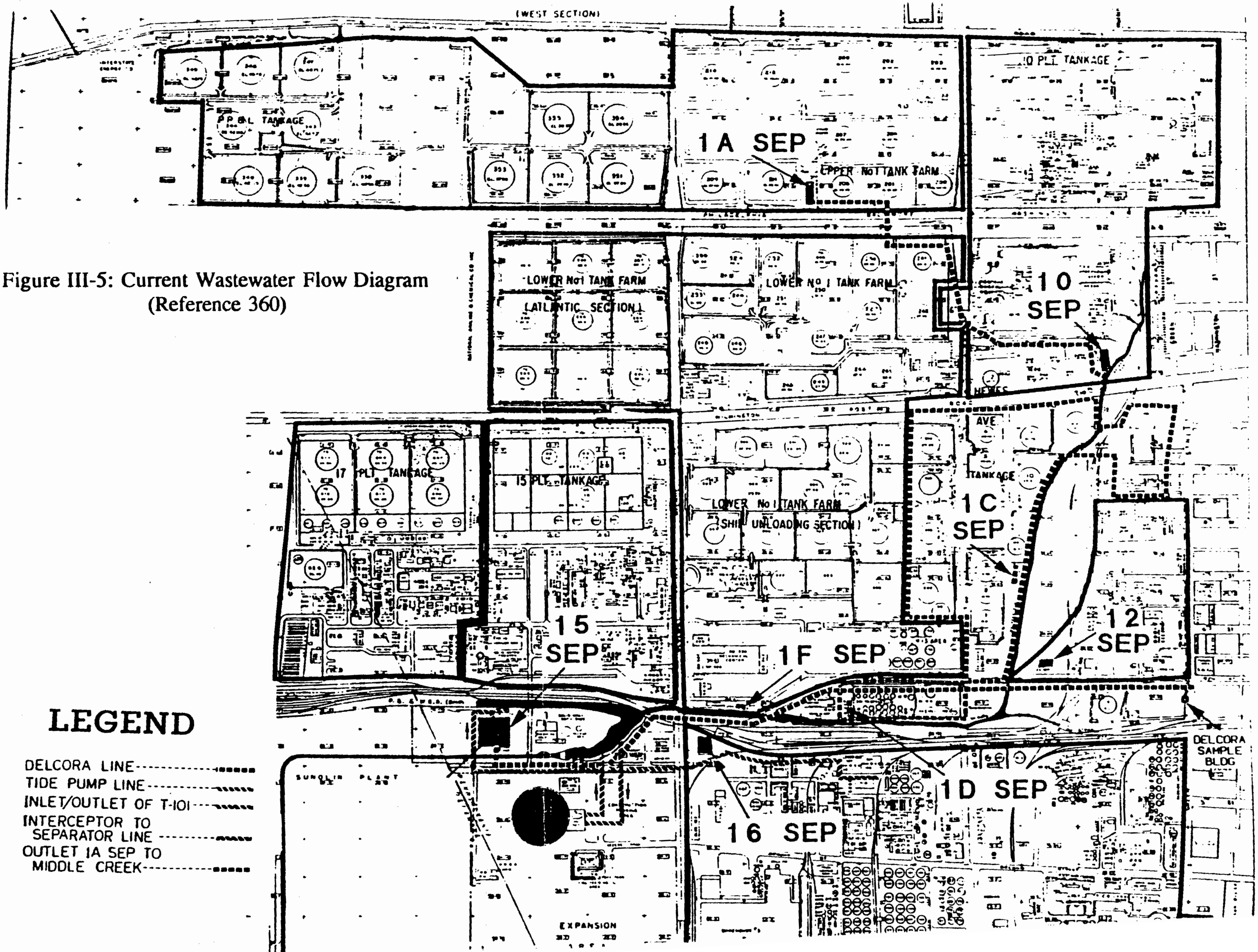


Figure III-5: Current Wastewater Flow Diagram
(Reference 360)

plate separators, including the 1F and 12A Oil/Water Separators (SWMUs 68 and 83), are still in use and also discharge to Middle Creek above the interceptor dam (References 359, 360, and 369).

The wastewater discharged into the Middle Creek Surface Drainage System (SWMU 96) above the interceptor dam is pumped from an impounded area behind the interceptor dam to the 15C - H Oil/Water Separators (SWMUs 89 - 94). Prior to pumping, pH adjustment is conducted in the impounded area. Additional influent to the 15C - H Separators is piped from an intercepter sewer in the southeastern portion of the facility. Wastewater from the western process and tank areas (15 and 17 Plants) flows directly into the 15A and B Oil/Water Separators (SWMUs 87 and 88). From the 15 Separators the wastewater is piped off-site to the DELCORA wastewater treatment plant for secondary treatment. Wastewater storage capacity (in addition to that provided by the impounded part of the Middle Creek Surface Drainage System (SWMU 96)) is provided by Impoundment Tank T-101 (SWMU 32). Water is transferred back and forth between the impounded basin and Impoundment Tank T-101 as necessary to regulate the amount of available wastewater storage capacity (References 111, 137, 359, 360, and 369).

Non-contact cooling water from the York and Elliott compressors, diverted off-site surface water runoff that flows through the Linwood bypass, untreated groundwater seepage, overflows of the Middle Creek Surface Drainage System (SWMU 96) interceptor dam, and storm water runoff from the ethylene complex and other western areas of MHR are discharged into the portion of the Middle Creek Surface Drainage System (SWMU 96) below the interceptor dam. This lower part of the Middle Creek Surface Drainage System (SWMU 96) flows into the Delaware River (References 111, 137, 369).

Other SWMUs associated with the wastewater management system include the 1F Oil/Water Separator Feed Trench (SWMU 69) and the Discharge Pipe and Excavation at 9 and 14 Oil/Water Separators (SWMU 80).

Slop Oil System

Oil separated from wastewater in oil/water separator units is trucked (15 Oil/Water Separators (SWMUs 87 - 94) or pumped (all other separators) from the units to the Slop Oil Tanks. Oil that is pumped flows directly to Slop Oil Tank 132 (SWMU 59). Oil that is trucked is discharged into Slop Oil Tank V-29 (SWMU 58), and then piped to Tank 132. Water and solids are separated from the oil in Tank 132, and the oil is pumped to Slop Oil Tank 388 (SWMU 60). Water and solids are again separated from the oil in Tank 388, and the oil is used as feedstock in the refinery production processes.

Ballast water is pumped from tanker ships unloading at the MHR docks to Ballast Water Tank W-12 (SWMU 61).

Refinery Sludges and Slurries Management System

Refinery sludges and slurries currently generated at MHR include oil/water separator sludges (EPA Hazardous Waste Numbers **K051** and F037), tank cleaning sludges (some of which are EPA Hazardous Waste Number K052), slop oil solids, and heat exchanger bundle cleaning sludge (EPA Hazardous Waste Number K050). In the past acid sludges and oil saturated treatment clays and filter media were also generated (References 14, 323, 369, and 370).

Little detailed information was obtained regarding practices used to manage these wastes prior to 1970. However, there are five locations at MHR where these types of wastes were disposed of in the past, including the Old Sludge Basin and Old Decant Basin (SWMUs 23 and 24), Old 12 Plant Sludge Basin (SWMU 25), Old 18 Plant Sludge Basin (SWMU 26), and the Phillips Island Area (SWMU 27).

The CERCLA files reviewed provide some insight into past practices used for disposal of these types of wastes from the MHR. The CERCLA files address the Read-Boyd Farm Site, which is located one and a half miles from the MHR (not contiguous to the refinery), and indicate that the wastes disposed of at that location between approximately 1925 and 1971 were generated at the MHR. According to an in-depth study of the Read-Boyd Farm conducted in 1975 by Metcalf and Eddy, Inc. for the Sun Oil Company (Reference 323), operating records for the site have not been located and little data is available on the types and quantities of wastes disposed of at the site.

However, it is believed that until 1964, liquid acid sludges from sulfuric acid treatment of oils were discharged into pits, and oil saturated clays and filter media were dumped on waste piles. Between the years of 1964 and 1971, it is believed that only miscellaneous refinery wastes were disposed of at the site. All disposal activity ceased in 1971. Estimates by Metcalf and Eddy indicate that there currently are 918,900 cubic yards of wastes located at the Read-Boyd Farm disposal area (1,300 yd^3 of sludge in settling ponds; 413,700 yd^3 of sludge in pits; 115,600 yd^3 of mixed filter clays, solid wastes, and acid sludge in pits; and 388,300 yd^3 of waste in waste piles) (Reference 323).

Currently, the MHR generates hazardous wastes that are typical of the petroleum refining industry. Wastes identified in the Draft Hazardous Waste Permit for the MHR include: slop oil emulsion solids (K049); heat exchanger bundle cleaning sludge (K050); API separator sludge (K051); leaded tank bottoms (K052); miscellaneous sludges (D001, D007, D008); mineral spirits and/or ethyl mercaptan (D001); spent non-halogenated solvents (F003); spent cresols, cresylic acid, and nitro-benzene (F004); spent toluene, MEK, CS_2, isobutanol, and pyridine (F005); caustic additives (D002); barium wastes (D005); chromium wastes (D007), lead wastes (D008), and various commercial chemical products (U019, U052, U056, U077, U135, U151, U159, U188, U220, U226, U239, P022, P110). Dissolved Air Flotation (DAF) float (K048) is not generated at MHR, although it may be in the future (References 14, 111, 269).

No wastes are currently disposed of on-site (Reference 14). The main process used to manage hazardous waste at MHR is the Solid Waste Facility (SWF) (SWMUs 1 - 21), which is located to the north of SunOlin Road in the western portion of the refinery.

The SWF was constructed in 1979 to accomplish two purposes: 1) reduce the quantity of wastes disposed of off-site was to be reduced; and 2) recover oil from the wastes and reprocessed through the MHR slop oil system (SWMUs 58 - 60). At the SWF, hazardous and non-hazardous sludges and slurries generated at MHR and received from other **Sun facilities** are treated to remove water and recover oil. The SWF process, which is conducted in a series of tanks (SWMUs 1 - 13 and 17 - 20) and a pressure filter press (SWMU 22), treats API separator sludges from both contaminated and non-contaminated separators (K051), leaded (K052) and unleaded tank bottoms, neutralized acid sludge tank bottoms, spent clay that was generated in the past in lubricating oil production at the Contact Plant, and catalyst fines generated in the Fluid Catalytic Cracking Unit (FCCU).

In the past, spent clay was loaded for transport from the contact plant at the Clay Contact Plant Area (SWMU 57) and received and stored at the SWF in the Lime, Spent Clay, and Catalyst Loading System (SWMU 18). The catalyst fines are loaded for transport from the FCCU at the 10-4 Plant Catalyst Fines Collection Roll-Offs (SWMUs 35 - 39) and received and stored at the SWF in the Catalyst Fines Silo (SWMU 17). Refinery sludges and slurries are trucked to the SWF and pumped into the Sludge Receiving Trough (SWMU 19), and then to the Tank Nos. 1 - 3 Receiving Tanks (SWMUs 1 - 3). The sludges are then stored in the Tank No. 4 Storage Tank (SWMU 4) and decanted in the Tank No. 5 Decant Tank (SWMU 5). Oil and water are removed from Tanks 4 and 5 and further separated in the Tank No. 6 Collection and Transfer Tank (SWMU 6). The sludges are then pumped to the treatment tanks (SWMUs 7 - 16), and finally to the Sludge Filter Press (SWMU 20). The treatment process results in a dry filter cake, slop oil, and a wastewater stream. The filter cake is emptied into roll-off containers in the Filter Cake Knock Out Area (SWMU 21) and sent off-site for disposal. The wastewater is discharged to the Middle Creek Surface Drainage System (SWMU 96) and subsequently piped to the DELCORA POTW. The oil is returned to the MHR slop oil system for reprocessing (SWMUs 58 - 60) (References 14, 15).

A simplified illustration of the SWF treatment process flow is presented as Figure III-6. A more detailed process and instrumentation diagram for the process is presented as Figure III-7. Figures III-8, III-9, and III-10 illustrate the layout of the SWF.

General Refuse and Materials Collection and Disposal System

Various types of wastes generated throughout the MHR are collected and disposed of off-site. These include asbestos removed from buildings and process areas, scrap metal, general refuse, demolition debris, contaminated soils excavated after spills or leaks, and laboratory wastes. All of these wastes are accumulated in small quantities and collected by MHR personnel for off-site disposal. The majority of these wastes are stored in roll-off boxes that may be staged in locations including the Phillips Island Roll-off Storage Area (SWMU 29) or the Phillips Island Old Drum Storage/Small Roll-Off Area (SWMU 30). Used equipment is stored in the Phillips Island Maintenance Storage Area (SWMU 28) prior to later off-site disposal or reuse at the facility. Laboratory wastes are collected and stored at the Laboratory Waste Accumulation Building (SWMU 52) prior to off-site disposal at a hazardous treatment and disposal facility. Used oil is collected in drums throughout the facility at the Used Oil Accumulation Areas (SWMU 100) prior to return to the slop oil system (SWMUs 58 - 60).

Previously, MHR had planned to store hazardous wastes generated at MHR and at other refineries on the Hazardous Waste Container Storage Pad (SWMU 22), which is included in the draft MHR hazardous waste management permit. However, it was decided not to manage such wastes from off-site and reportedly no waste has been stored on the pad.

Process Area Waste Management

Several waste management activities are related to the 10-4 Plant, which includes the Fluid Catalytic Cracking Unit (FCCU). The catalyst used in the FCCU is continually regenerated in the 10-4 Plant Catalyst Regeneration Unit (SWMU 44). When spent catalyst is removed from the system, it is stored in the 10-4 Plant Spent Catalyst Silo (SWMU 41), prior to transport to the 10-4 Plant Roll-Off Storage Area (SWMU 40). Catalyst fines are removed from air streams in the 10-4 Plant Electrostatic Precipitators (SWMU 42), and collected in the 10-4 Plant Catalyst Fines Collection Roll-Offs (SWMUs 35 - 39) prior to transport to the 10-4 Plant Roll-Off Storage Area (SWMU 40). From this area, the spent catalyst may be stored further at the Phillips Island Roll-Off Storage Area (SWMU 29) prior to transport off-site for disposal, and the catalyst fines are transported to the Solid

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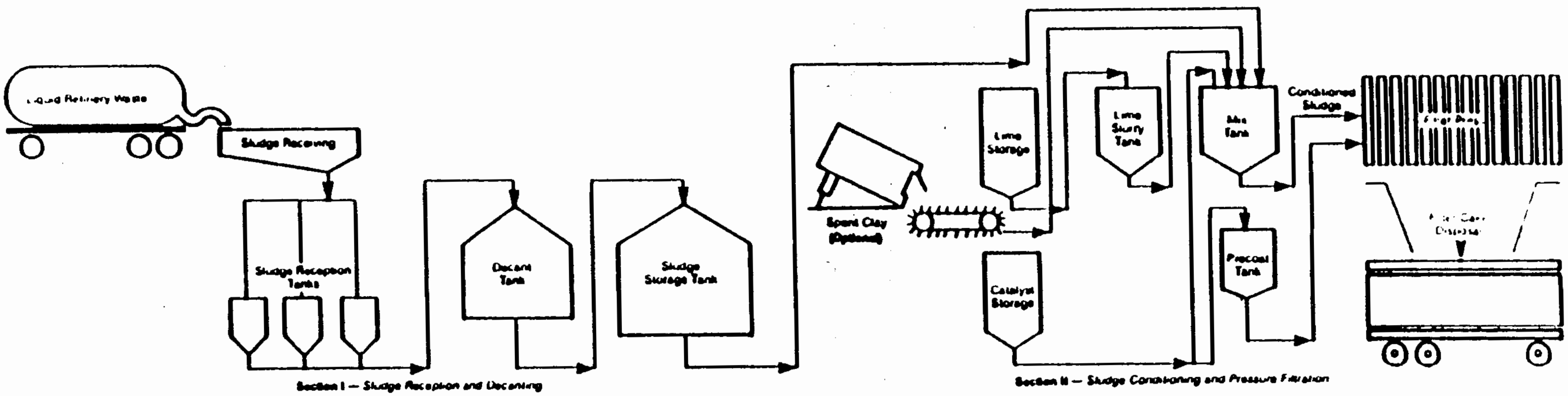

Figure III-6: Solid Waste Facility Simplified Flow Diagram
(Reference 14)

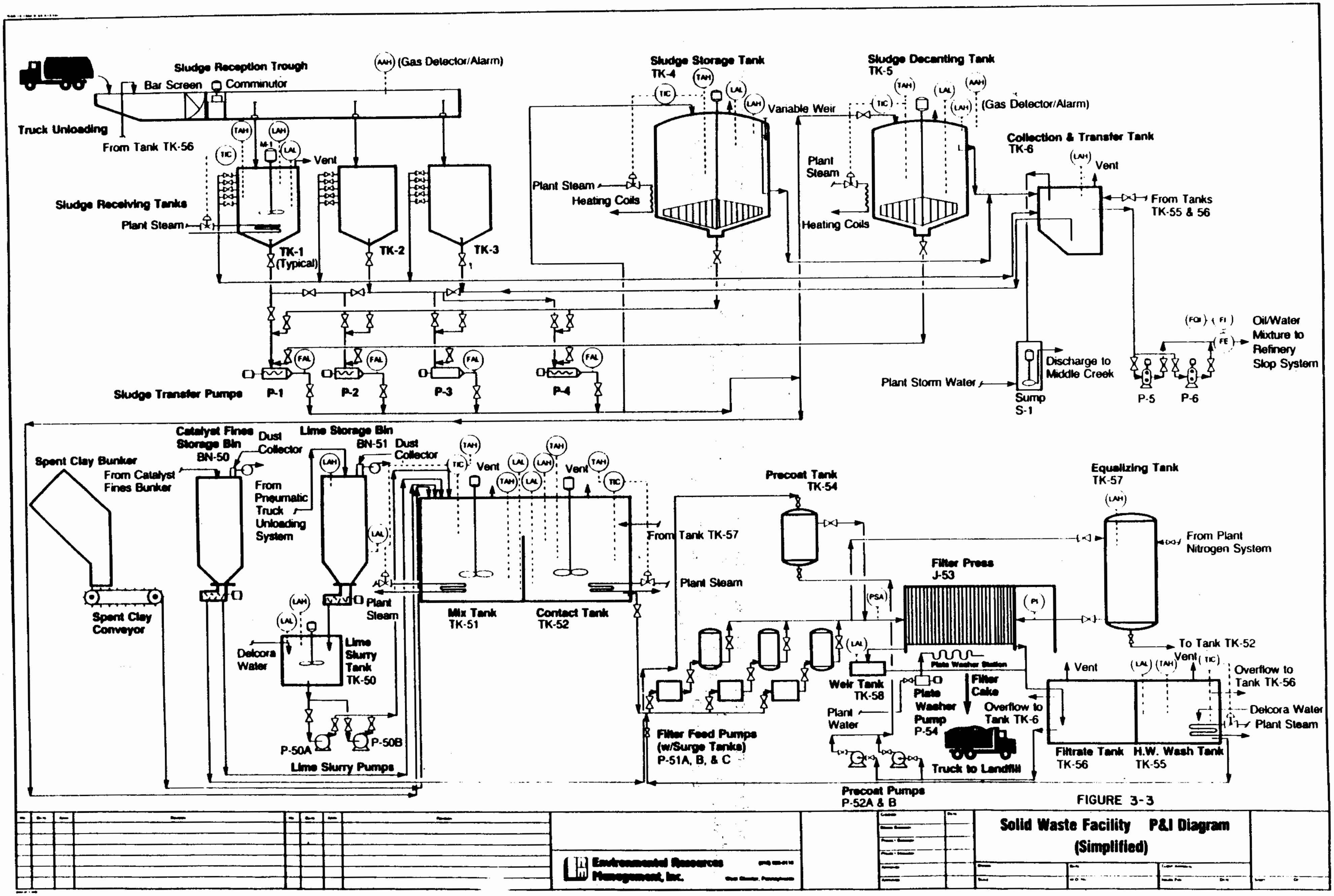

Figure III-7: Solid Waste Facility P and I Diagram
(Reference 10)

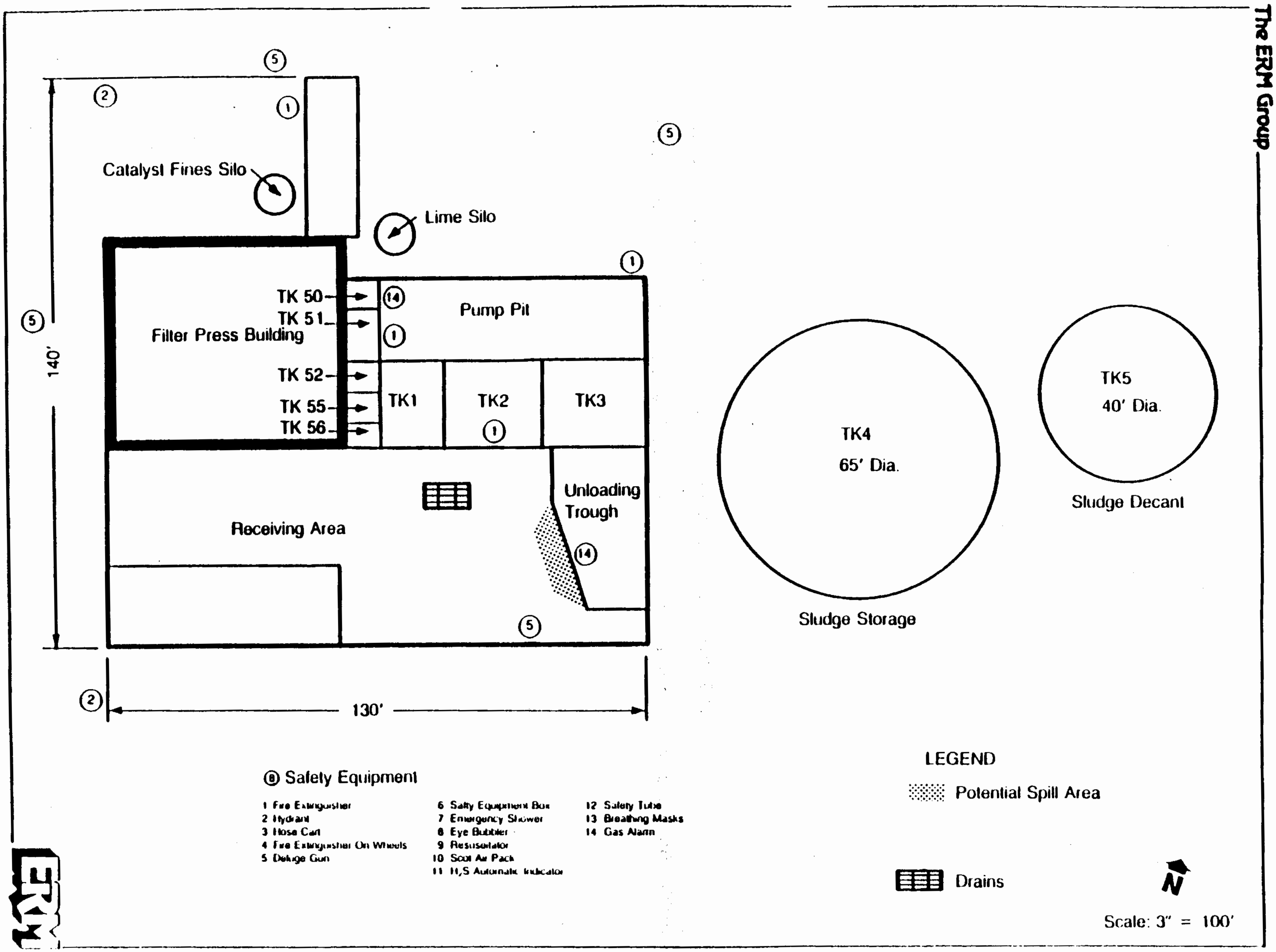

Figure III-8: Solid Waste Facility Layout
(Reference 14)

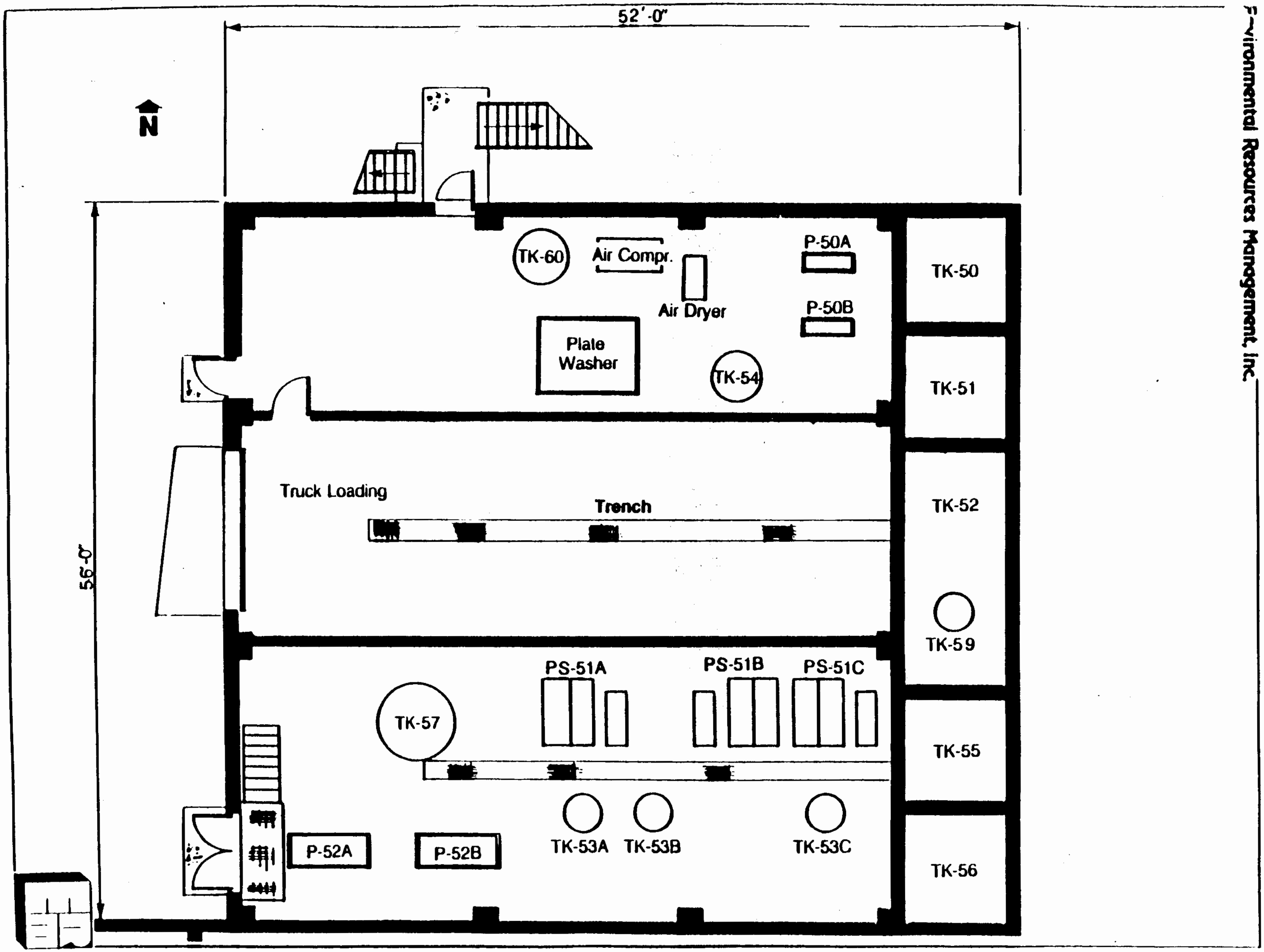

Figure III-9: Solid Waste Facility Filter Press Building First Floor Layout Diagram
(Reference 14)

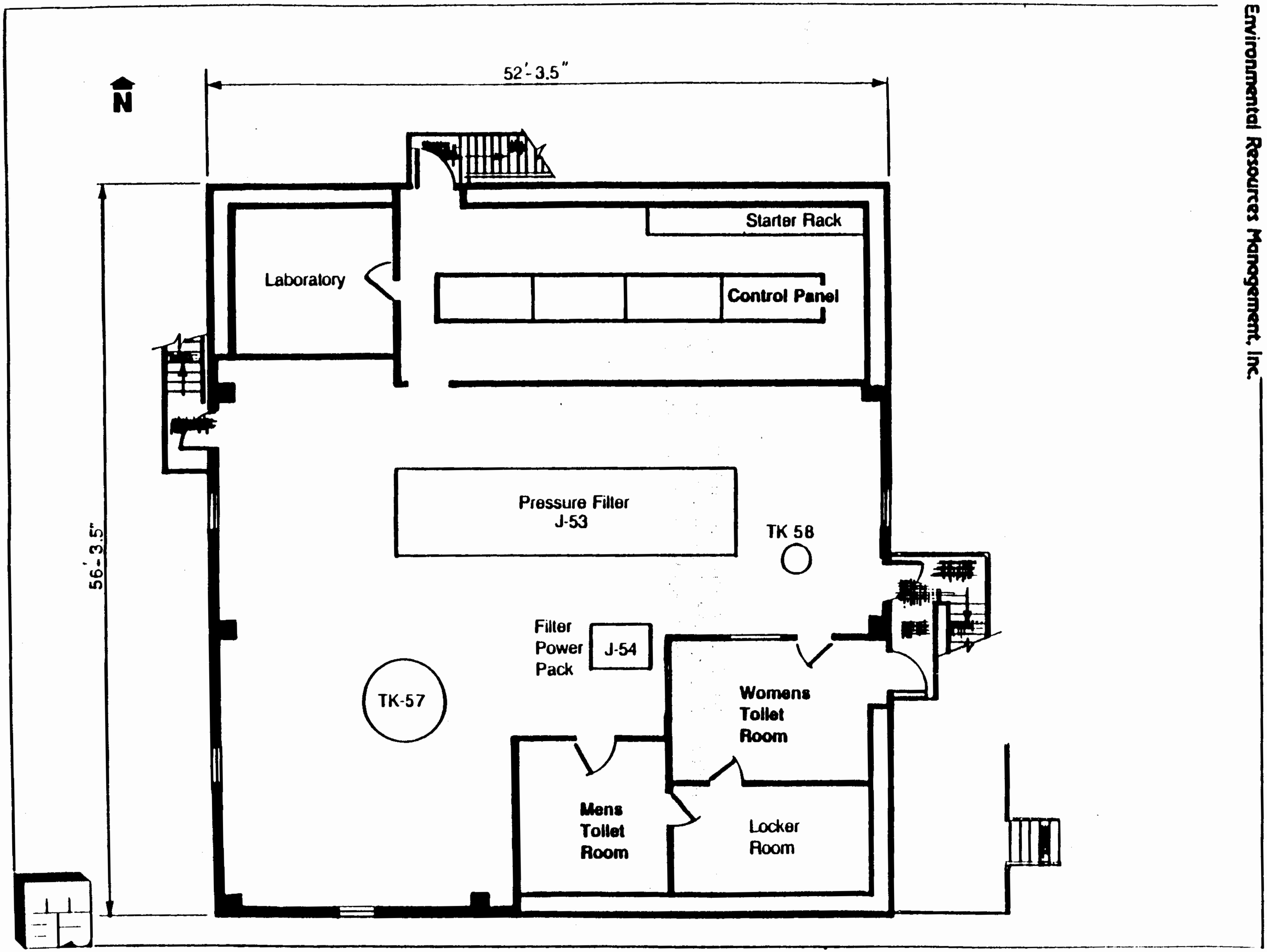

Figure III-10: Solid Waste Facility Filter Press Building Second Floor Layout Diagram
(Reference 14)

Waste Facility (SWMUs 1 - 21) and used in the treatment process. A wastewater stream generated at the 10-4 Plant is treated in the 10-4 Plant Sour Water Stripper (SWMU 43) prior to discharge to the 10 Oil/Water Separators (SWMUs 81, 82) and then the Middle Creek Surface Drainage System (SWMU 96).

Waste management activities related to the Mechanical Shop and Garage include equipment cleaning in the Garage High Pressure Wash Area (SWMU 45) and the Mechanical Shop Equipment Wash Rack (SWMU 50) and sand blasting of equipment in the Mechanical Shop Sand Blast Unit (SWMU 48). Waste oil removed from vehicle crank cases is collected in the Garage Aboveground Waste Oil Tank (SWMU 46) prior to return to the Slop Oil System (SWMUs 58 - 60). Saw dust from carpentry operations is collected in the Mechanical Shop Saw Dust Collector (SWMU 47) and metal fines from dry surface coating are collected in the Mechanical Shop Wire Spray Unit (SWMU 49).

Ancillary Activities

Wastes generated in equipment cleaning and maintenance in locations other than the Mechanical Shop and Garage include sand blast residues accumulated at the Phillips Island Sand Blasting Area (SWMU 34) and wastewater and residues generated and managed at the 8-C Crude Unit Drip Showers (SWMU 53). Wastes generated in loading and unloading and materials transport operations include residues generated at the Benzene Vapor Recovery System (SWMU 55) (no longer in use), in the Product Drip Collection Areas (SWMU 97), the Rail Car Loading/Unloading Areas and Associated Tracks (SWMU 99), and the Underground Transfer Lines (AOC B).

Wastes generated in product storage operations include residues associated with Aboveground Tank Containment Areas (SWMU 98), Underground Storage Tank Excavation Areas (AOC C), Underground Storage Tanks (AOC D), and Underground Storage Caverns (AOC E). Wastes and residues associated with past activities no longer conducted include residues remaining at the Asphalt Plant Area (SWMU 56), the Clay Contact Plant Area (SWMU 57), and the B & P Warehouse Drum Loading Area (SWMU 54). Residues generated in fire fighter training are managed at the Fire Fighter Training Area (SWMU 31). Additional units or areas of concern identified during the VSI include the Dock No. 2 Recovery Well System (SWMU 51) which manages a kerosene-like substance removed from the subsurface in the Kerosene Contamination Area (AOC H), the 8-C Plant PCB Transformer Area (AOC F), the 1F Oil/Water Separator Electrical Box (AOC G), and other Stained Refinery Areas (AOC A).

<u>History of Releases</u>

Numerous releases of pollutants to air, surface water, soil, and groundwater from the MHR are documented in the regulatory file material. Documentation of releases to air and surface water is the most extensive, documentation of releases to soil is more limited, and releases to groundwater are only evidenced by the recovery of quantities of a hydrocarbon substance from a recovery well at the refinery. The documented releases to each environmental media are summarized below.

Throughout the record of regulatory activity at MHR, releases to air are well documented (References 155 - 320). Releases are documented through both regulatory staff inspection reports and facility self-reporting notification letters. Documented air releases fall into two categories; continuous emissions limit exceedances under normal operating conditions, and short term exceedances due to process upsets. Continuous emissions limit exceedances are generally documented through PADER correspondence and address emissions of particulates, volatile organic compounds, SO_x, odors, visible emissions (opacity), and benzene. The most frequently noted continuous emissions violations were associated with the FCCU, which has historically exceeded both particulates and SO_x limits. The MHR installed electrostatic precipitators (SWMU 42) to control particulates emissions from the unit (References 155 - 320).

Short term air emissions due to process upsets are generally documented through facility self reporting, inspection reports, and citizen complaints. These short term violations are generally visible emissions (opacity) violations due to process upsets which cause bypasses of control systems (References 155 - 320).

Throughout the record of regulatory activity at MHR in the area of surface water discharge control, releases to surface waters are also well documented (References 108 - 154). As with air emissions, releases to surface water are documented through both regulatory documentation (inspection reports) and facility self-reporting. Self reporting notices, which are more numerous, include discharge monitoring reports (DMRs), which are required for the NPDES permitted discharge points, and notifications of spills to surface waters required under the Oil Pollution Prevention regulations of 40 CFR Part 112. The DMRs for the MHR outfalls (various 101 outfalls on Middle Creek) report violations of Total Organic Carbon (TOC), Chemical Oxygen Demand, (COD), Total Suspended Solids (TSS), oil and grease, and pH. The most frequently reported exceedances are for oil and grease, followed by TOC (References 108 - 154).

The files reviewed contained at least 18 MHR notifications of releases of oil to surface waters. Most of the reports address releases to the Delaware River, and several address releases to the Delaware via Middle Creek. Several of the releases are from loading and unloading of petroleum products to and from ships at the docks on the Delaware. The remaining releases are from unknown sources. Response operations such as placement of booms and oil recovery are described in the reports (References 108 - 154).

Documentation of releases to soils at the MHR includes approximately ten spills of materials in areas where the presence of containment structures and clean-up operations is not documented (References 152, 174, 186, 236, 245, 292, 317, 318, 344). These areas, and any additional spill areas at the refinery, have been identified as AOC A and are described further in Chapter IV.

No releases to groundwater are explicitly documented in the file material. However, the quantities of a kerosene-like substance that have been recovered from a well located near Dock No. 2 (31,000 gallons by the end of 1988; Reference 147), and the shallow water table in the area, indicate that releases have occurred to groundwater (References 141, 147, 149, 150, 151, 152). Although it was suggested that the source of the release might be underground transfer lines (AOC B), no definitive identification of the source was documented in the files (Reference 141). This area of contamination has been identified as AOC H and is described further in Chapter IV.

During the VSI, numerous instances of staining on soils and other areas of MHR were noted and documented under AOC A in the attached Photograph Log. Releases to surface water (lower portion of Middle Creek, which discharges to the Delaware River) were also documented. The Middle Creek Surface Drainage System (SWMU 96) was noted to be unlined and to contain large quantities of oily sludges and liquids. The integrity of numerous additional units could not be determined due to their in-ground construction, but were noted to contain oily sludges and liquids. Most of these units also had associated staining on soil in the vicinity of the unit.

List of SWMUs and AOCs

Table III-2 is a list of the 100 SWMUs and eight AOCs identified at MHR during the PR and VSI. The locations of these units are illustrated on the SWMU and AOC Location Map, included as Attachment A. Specific locations within the Solid Waste Facility are provided for SWMUs 1 - 8, 12, 13, 15, and 17 - 19 on Figure III-11, and for SWMUs 9 - 11, 14, 16, 20, and 21 on Figure III-12. Specific locations are provided for SWMUs 23 - 25, 30, and 54 on Figure III-13. The SWMUs and AOCs are described in Section IV of this report.

TABLE III-2: LIST OF SWMUS AND AOCS
SUN REFINING AND MARKETING COMPANY
MARCUS HOOK REFINERY

SOLID WASTE FACILITY

SWMU NO. 1.	Tank No. 1 Receiving Tank*
SWMU NO. 2.	Tank No. 2 Receiving Tank*
SWMU NO. 3.	Tank No. 3 Receiving Tank*
SWMU NO. 4.	Tank No. 4 Sludge Storage Tank*
SWMU NO. 5.	Tank No. 5 Sludge Decant Tank*
SWMU NO. 6.	Tank No. 6 Collection and Transfer Tank*
SWMU NO. 7.	Tank No. 51 Mix Tank*
SWMU NO. 8.	Tank No. 52 Contact Tank*
SWMU NO. 9.	Tank No. 53a Surge Tank*
SWMU NO. 10.	Tank No. 53b Surge Tank*
SWMU NO. 11.	Tank No. 53c Surge Tank*
SWMU NO. 12.	Tank No. 56 Filtrate Tank*
SWMU NO. 13.	Tank No. 50 Lime Slurry Tank
SWMU NO. 14.	Tank No. 54 Precoat Tank
SWMU NO. 15.	Tank No. 55 Hot Water Wash Tank
SWMU NO. 16.	Tank No. 57 Equalizing Tank
SWMU NO. 17.	Catalyst Fines Silo
SWMU NO. 18.	Lime, Spent Clay, and Catalyst Loading System
SWMU NO. 19.	Sludge Receiving Trough
SWMU NO. 20.	Sludge Filter Press
SWMU NO. 21.	Filter Cake Knock-Out Area

HAZARDOUS WASTE CONTAINER STORAGE

SWMU NO. 22.	Hazardous Waste Container Storage Pad*

SLUDGE MANAGEMENT UNITS

SWMU NO. 23.	Old Sludge Basin
SWMU NO. 24.	Old Decant Basin
SWMU NO. 25.	Old 12 Plant Sludge Basin
SWMU NO. 26.	Old 18 Plant Sludge Basin

* RCRA Regulated Unit

TABLE III-2 (CONTINUED): LIST OF SWMUS AND AOCS
SUN REFINING AND MARKETING COMPANY
MARCUS HOOK REFINERY

PHILLIPS ISLAND

SWMU NO. 27.	Phillips Island Area
SWMU NO. 28.	Phillips Island Maintenance Storage Area
SWMU NO. 29.	Phillips Island Roll-Off Storage Area
SWMU NO. 30.	Phillips Island Old Drum Storage/Small Roll-Off Area
SWMU NO. 31.	Fire Fighter Training Area
SWMU NO. 32.	Impoundment Tank T-101
SWMU NO. 33.	Phillips Island Surface Drainage Ditches
SWMU NO. 34.	Phillips Island Sand Blasting Area

10-4 PLANT

SWMU NO. 35-39.	10-4 Plant Catalyst Fines Collection Roll-Offs
SWMU NO. 40.	10-4 Plant Roll-Off Storage Area
SWMU NO. 41.	10-4 Plant Spent Catalyst Silo
SWMU NO. 42.	10-4 Plant Electrostatic Precipitators
SWMU NO. 43.	10-4 Plant Sour Water Stripper
SWMU NO. 44.	10-4 Plant Catalyst Regeneration Unit

MECHANICAL SHOP/GARAGE

SWMU NO. 45.	Garage High Pressure Wash Area
SWMU NO. 46.	Garage Aboveground Waste Oil Tank
SWMU NO. 47.	Mechanical Shop Saw Dust Collector
SWMU NO. 48.	Mechanical Shop Sand Blast Unit
SWMU NO. 49.	Mechanical Shop Wire Spray Unit
SWMU NO. 50.	Mechanical Shop Equipment Wash Rack

MISCELLANEOUS UNITS

SWMU NO. 51.	Dock No. 2 Recovery Well System
SWMU NO. 52.	Laboratory Waste Accumulation Building
SWMU NO. 53.	8-C Crude Unit Drip Showers
SWMU NO. 54.	B & P Warehouse Drum Loading Area
SWMU NO. 55.	Benzene Vapor Recovery System
SWMU NO. 56.	Asphalt Plant Area
SWMU NO. 57.	Clay Contact Plant Area
SWMU NO. 58.	Slop Oil Tank V-29
SWMU NO. 59.	Slop Oil Tank 132
SWMU NO. 60.	Slop Oil Tank 388
SWMU NO. 61.	Ballast Water Tank W-12
SWMU NO. 62.	Heat Exchanger Bundle Cleaning Area

TABLE III-2 (CONTINUED): LIST OF SWMUS AND AOCS
SUN REFINING AND MARKETING COMPANY
MARCUS HOOK REFINERY

OIL/WATER SEPARATOR UNITS

SWMU NO. 63.	1A Oil/Water Separator
SWMU NO. 64.	1B Oil/Water Separator
SWMU NO. 65.	1C Oil/Water Separator
SWMU NO. 66.	1D Oil/Water Separator
SWMU NO. 67.	1E Oil/Water Separator
SWMU NO. 68.	1F Oil/Water Separator
SWMU NO. 69.	1F Oil/Water Separator Feed Trench
SWMU NO. 70-79.	9 and 14 Oil/Water Separators
SWMU NO. 80.	Discharge Pipe and Excavation at 9 and 14 Oil/Water Separators
SWMU NO. 81, 82.	10 Oil/Water Separators
SWMU NO. 83.	12A Oil/Water Separator
SWMU NO. 84-86.	16 Oil/Water Separators
SWMU NO. 87-94.	15 Oil/Water Separators

FACILITY-WIDE UNITS

SWMU NO. 95.	Combined Process/Storm Sewer System
SWMU NO. 96.	Middle Creek Surface Drainage System
SWMU NO. 97.	Product Drip Collection Areas
SWMU NO. 98.	Aboveground Tank Containment Areas
SWMU NO. 99.	Rail Car Loading/Unloading Areas and Associated Tracks
SWMU NO. 100.	Used Oil Accumulation Areas

AREAS OF CONCERN

AOC A.	Stained Refinery Areas
AOC B.	Underground Transfer Lines
AOC C.	Underground Storage Tank Excavation Areas
AOC D.	Underground Storage Tanks
AOC E.	Underground Storage Caverns
AOC F.	8-C Plant PCB Transformer Area
AOC G.	1F Oil/Water Separator Electrical Box
AOC H.	Kerosene Contamination Area

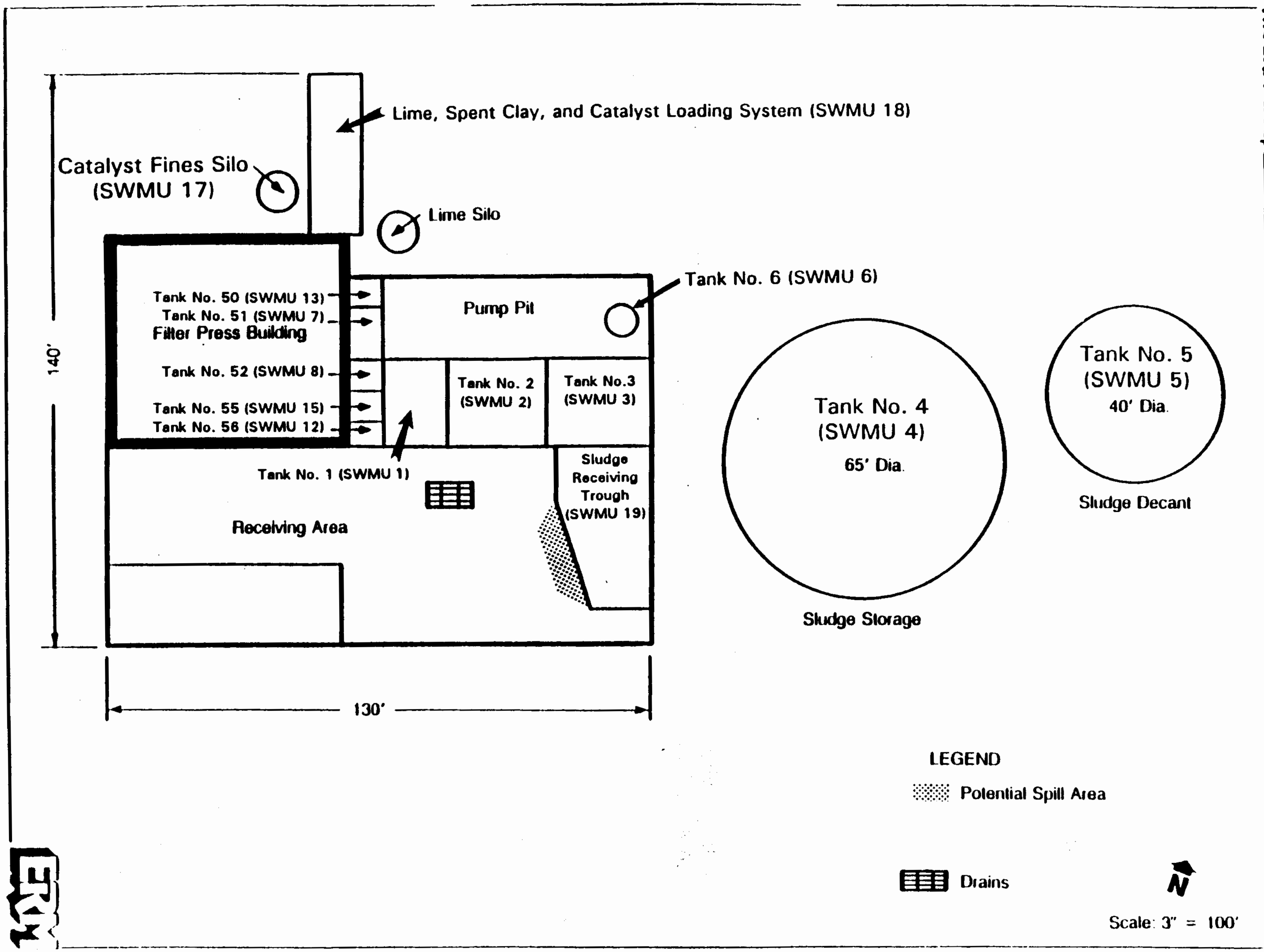

Figure III-11: Location Map for SWMUs 1-8, 12, 13, 15, 17-19
(Reference 14)

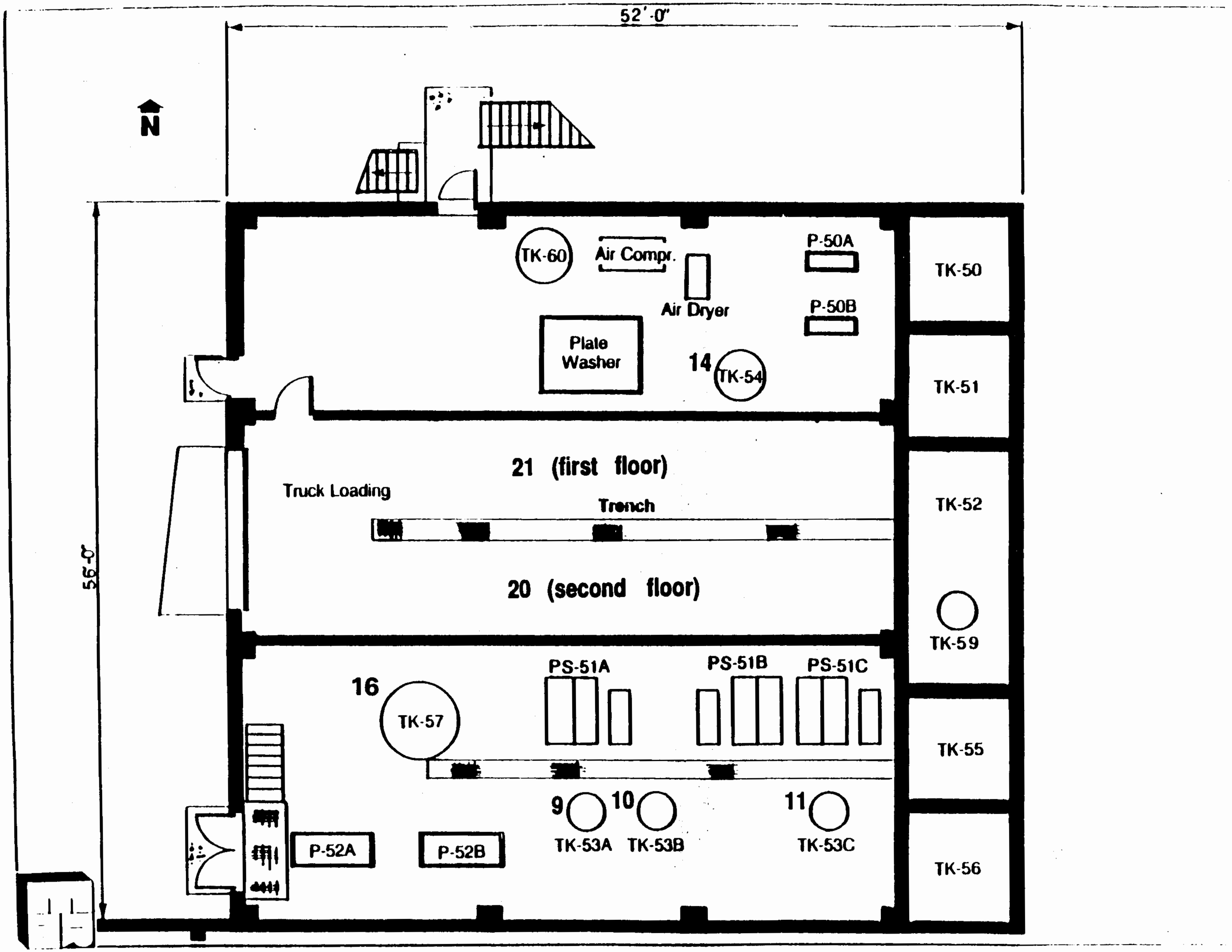

Figure III-12: Location Map for SWMUs 9, 10, 11, 14, 16, 20, 21
(Reference 14)

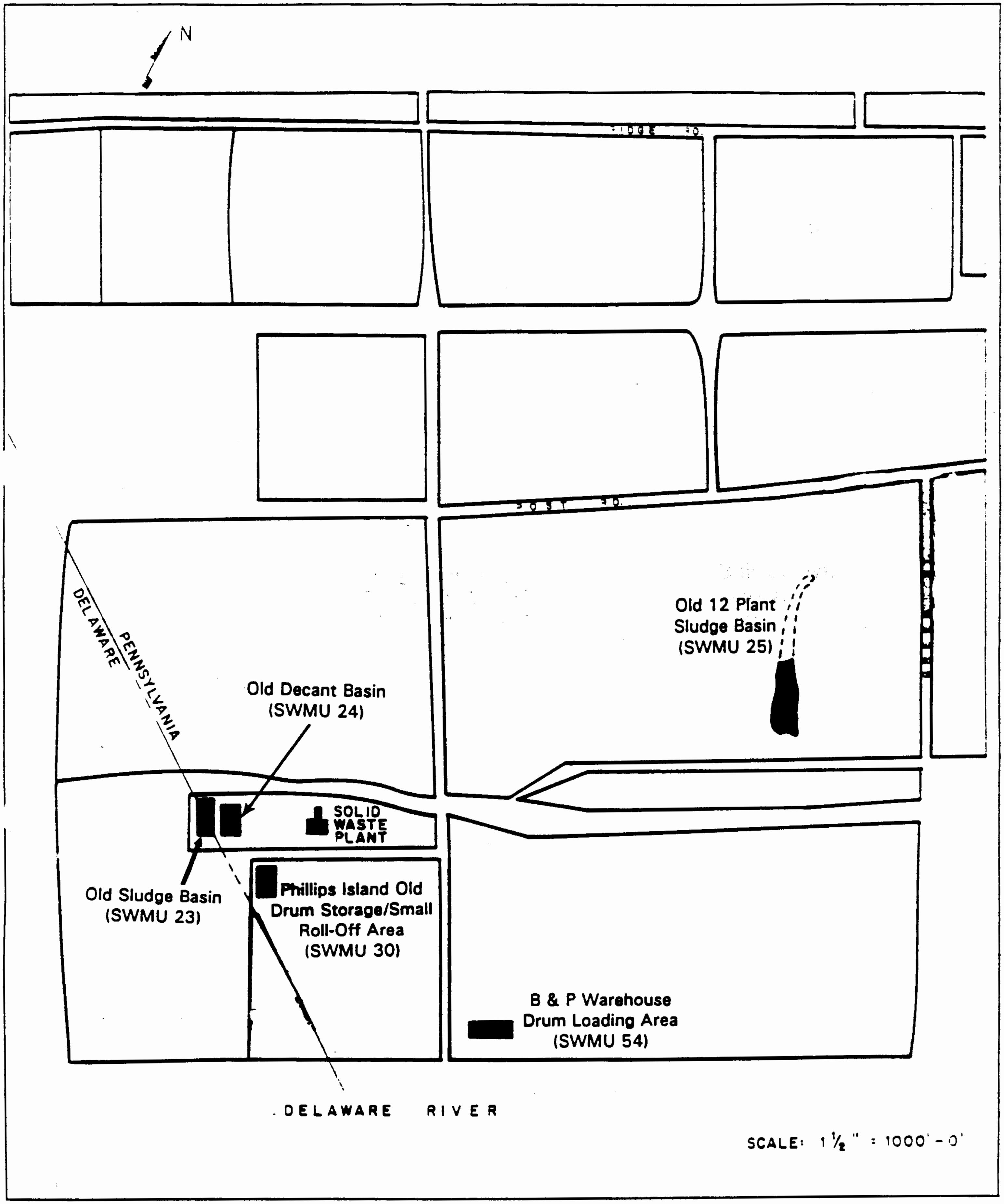

Figure III-13: Location Map for SWMUs 23-25, 30, 54
(Reference 2)